U.S. Department of Energy
Hanford Site

July 10, 2020

20-ESQ-0075

Ms. Alexandra K. Smith, Program Manager
Nuclear Waste Program
Washington State Department of Ecology
3100 Port of Benton Boulevard
Richland, Washington 99354

Dear Ms. Smith:

CLASS 1 MODIFICATIONS TO THE HANFORD FACILITY RESOURCE CONSERVATION AND RECOVERY ACT PERMIT, QUARTER ENDING JUNE 30, 2020

In accordance with the Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste (Permit) Condition I.C.3, attached are Class 1 permit modification documents for the quarter ending June 30, 2020.

The attached modifications pertain to information contained in Parts I and II of the Permit (Standard and General Facility Conditions) and also Part III of the Permit, "Unit-Specific Conditions for Final Status Operations." The changes to Part I and II affect historical information about prior Permit modifications. The changes to Part III affect the Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility (Operating Unit Group 3), 325 Hazardous Waste Treatment Units (Operating Unit Group 5), Waste Treatment and Immobilization Plant (Operating Unit Group 10), and the Integrated Disposal Facility (Operating Unit Group 11).

The U.S. Department of Energy and Washington State Department of Ecology (Ecology) use Permit Change Notices (PCNs) to help track Class 1 permit modifications. This modification package addresses the following PCNs:

PCN Identifier:	Affected Permit Section:
PCN-HFSW-2020-01	Parts I & II
PCN-LERF/ETF-2020-01	OUG-3, Unit Specific Conditions and Addendum C
PCN-325-2020-01	OUG-5, Unit Specific Conditions and Addendum J
24590-LAW-PCN-ENV-19-005	OUG-10, Unit Specific Conditions and Appendix 9.9
PCN-IDF-2020-03	OUG-11 Unit Specific Conditions and Addendum J.1

Individuals may request hard copies if the electronic files cannot be accessed. Requests can be made to Ecology by contacting Ecology's Resource Center on (509) 372-7950.

If you have any questions, please contact me, or your staff may contact Brian J. Stickney, Assistant Manager for Safety and Environment, Richland Operations Office, on (509) 376-9079.

Sincerely,

Digitally signed by Brian T. Vance
DN: cn=Brian T. Vance, o=Office of River Protection, ou=Department of Energy, email=brian.t.vance@orp.doe.gov, c=US
Date: 2020.07.10 07:59:18 -07'00'

Brian T. Vance
Manager

ESQ:ACM

Attachment:
Class 1 Mod RCRA Permit, 6-30-20

cc w/attach:
D. J. Alexander, Ecology (CD ROM)
J. L. Cantu, Ecology (CD ROM)
Administrative Record, TSD: H-0-1,
T-3-4, H-0-8, and D-2-11 (Hardcopy & CD ROM)
Ecology NWP Library (Hardcopy & CD ROM)
Environmental Portal, G3-35 (CD ROM)
HF Operating Record (J. K. Perry, MSA, A3-01)

cc w/o attach:
J. E. Bramson, CHPRC
R. E. Bullock, CHPRC
A. S. Carlson, Ecology
S. L. Dahl, Ecology
S. A. Davis, BNI
L. M. Dittmer, CHPRC
M. D. Ellefson, PNNL
M. E. Jones, Ecology
P. W. Martin, CHPRC
M. T. Schanke, CHPRC
B. A. Sparks, BNI
S. A. Thompson, WRPS
E. J. Van Mason, WRPS
M. B. Wilson, MSA

Attachment

20-ESQ-0075

Class 1 Modifications for Quarter Ending Jone 30, 2020

Consisting of 148 pages,
including this cover page

Hanford Facility RCRA Permit Modification Notification Forms

Parts I & II (Standard & General Facility Conditions)

Index

Reviewed by DOE Program Office:

DOE Program Office Name 4/20/20
Date

<table>
<tr><th colspan="5">Hanford Facility RCRA Permit Modification Form</th></tr>
<tr><td>Unit:

Not Applicable</td><td colspan="4">Permit Part
Parts I & II (Standard & General Facility Conditions)</td></tr>
<tr><td colspan="5"><u>Description of Modification:</u>

Pages 14 and 15 need to be revised to reflect permit change history information for the PUREX Storage Tunnels. Pages 49-50 need to be revised to indicate the PUREX Storage Tunnels unit group specific requirements are located in Part V. These revisions are associated with permit modification number 8C.2018.5F (Ecology Letter Number 18-NWP-195, dated 12/17/18).

Pages 13 and 15 need to be revised to reflect permit change history information for the 276-BA Storage Area. Pages 49-50 need to be revised to indicate 276-BA Storage Area unit group specific requirements are located in Part V. These revisions are associated with permit modification number 8C.2019.5F (Ecology Letter Number 19-NWP-084, dated 5/29/19).</td></tr>
<tr><td>WAC 173-303-830 Modification Class
Please mark the Modification Class:</td><td>Class 1
X</td><td>Class [1]1
</td><td>Class 2
</td><td>Class 3
</td></tr>
<tr><td colspan="5">Enter relevant WAC 173-303-830, Appendix I Modification citation number:

A.1 Administrative and informational changes . . . .</td></tr>
<tr><td>Modification Concurrence: [X] Yes [ ] No</td><td colspan="4">Reviewed by Ecology:
Schleif, Stephanie (ECY) Digitally signed by Schleif, Stephanie (ECY) Date: 2020.04.27 15:03:59 -07'00'
S. N Schleif Date</td></tr>
</table>

Instructions:

Revise Parts I & II as shown herein.

Unit Status Table

Permit Revision	Revision Date	Units Incorporated
Permit Revision 0	8/29/94	616 NDWSF, 305-B Storage Facility, 183-H SEB, 300 ASE, 2727-S, NRDWSF
Permit Revision 1	4/28/95	Simulated High-Level Waste Slurry, 218-E-9 Borrow Pit Demo Site, 200 W Area Ash Pit Demo Site, 2101-M Pond, 216-B-3 Expansion Ponds
Permit Revision 2	8/29/95	Hanford Patrol Academy Demolition Site, 105-DR Large Sodium Fire Facility, 304 Concretion Facility
Permit Revision 3	11/25/96	PUREX Storage Tunnels, 4843 Alkali Metal Storage Facility, 3718-F Alkali Metal Treatment & Storage Facility, 303-K Storage Facility, 300 APT
Permit Revision 4	1/28/98	LERF & 200 Area ETF, 242-A Evaporator, 325 HWTUs
Permit Revision 5	5/18/99	100 D Ponds, 1301-N & 1325-Liquid Waste Disposal Facility, 1324-N Surface Impoundment, 1324-NA Percolation Pond
Permit Revision 6	3/28/00	Permit Condition II.Y, Corrective Action
Permit Revision 7	2/27/01	Waste Treatment & Immobilization Plant, 300 Area WATS
Permit Revision 8	9/23/04	No new units, modification updates
Permit Revision 8A	3/6/06	Integrated Disposal Facility
Permit Revision 8B	1/2007	331-C Storage Unit, PFP Treatment Unit, 241-Z Treatment & Storage Tanks, 303-M Oxide Facility
Permit Revision 8C	8/2007	400 Area Waste Management Unit, 224-T TRUSAF
Permit Revision 8C (8C.2016.2F)	01/21/2016	FS-1 Outdoor Container Storage Area Closure
Permit Revision 8C (8C.2016.6F)	10/6/2016	207-A South Retention Basins
Permit Revision 8C (8C.2017.Q1)	04/26/2017	1706 KE Waste Treatment System
Permit Revision 8C (8C.2017.Q1)	04/26/2017	600 Area Purgewater Storage and Treatment Facility
Permit Revision 8C (8C.2019.5F)	05/29/19	276-BA Storage Area closure

Unit	Permit Revision		Comments/History
	Incorporated	Retired	
Part III, Operating Units			
616 Non-Radioactive Dangerous Waste Storage Facility	Rev. 6	Rev. 7	Closed, 9/5/01
242-A Evaporator	Rev. 4		
305-B Storage Facility	Rev. 0		Closed, 7/2/07
325 Hazardous Waste Treatment Units	Rev. 4		RLWT procedural closure, 9/04
LERF & 200 Area ETF	Rev. 4		
PUREX Storage Tunnels	Rev. 3		Unit group requirements were moved from Part III to Part V Revision 8C (8C.2019.5F, 12/17/18).
Waste Treatment and Immobilization Plant	Rev. 7		Permitted unit under construction
Integrated Disposal Facility	Rev. 8A		
331-C Storage Unit	Rev. 8B	Rev. 8C	Closed, 7/22/11
400 Area Waste Management Unit	Rev. 8C		
Part IV, Corrective Action			
100-NR-1 Operable Unit	Rev. 6		
100-NR-2 Operable Unit	Rev. 6	Rev. 8C	Retired, 9/30/09
Part V, Undergoing Closure Units			
100-D Ponds	Rev. 5	Rev. 6	Closed, 8/9/99
105 DR Large Sodium Fire Facility	Rev. 2	Rev. 6	Closed, 7/1/04
1301-N Liquid Waste Disposal Facility	Rev. 5	Rev. 8C	Closed, 11/28/18
1324-N Surface Impoundment	Rev. 5	Rev. 8C	Closed, 04/25/17
1324-NA Percolation Pond	Rev. 5	Rev. 8C	Closed, 04/25/17
1325-N Liquid Waste Disposal Facility	Rev. 5	Rev. 8C	Closed, 11/28/18
200 West Area Ash Pit Demo Site	Rev. 1	Rev. 6	Closed, 11/28/95
2101-M Pond	Rev. 1	Rev. 6	Closed, 11/28/95
216-B-3 Expansion Ponds	Rev. 1	Rev. 6	Closed, 7/31/95
218-E-8 Borrow Demolition Site	Rev. 1	Rev. 6	Closed, 11/28/95
2727-S Storage Facility	Rev. 0	Rev. 6	Closed, 7/31/95
300 Area Solvent Evaporator	Rev. 0	Rev. 6	Closed, 7/31/95

Unit	Permit Revision		Comments/History
	Incorporated	Retired	
300 Area Waste Acid Treatment System	Rev. 6	Rev. 8B	Closed, 1/21/05
303-K Storage Facility	Rev. 4	Rev. 6	Closed, 7/22/02
304 Concretion Facility	Rev. 2	Rev. 6	Closed, 1/21/96
311 Tanks (includes 300 Area WATS)	Rev. 6	Rev. 7	Closed, 5/20/02
3718-F Alkali Metal Treatment/Storage	Rev. 3	Rev. 6	Closed, 8/4/98
4843 Alkali Metal Storage Facility	Rev. 3	Rev. 6	Closed, 4/14/97
Hanford Patrol Academy Demo Site	Rev. 2	Rev. 6	Closed, 11/28/95
Simulated High Level Waste Slurry	Rev. 1	Rev. 6	Closed, 9/6/95
PFP Treatment Unit (HA-20MB)	Rev. 8B	Rev. 8B	Closed, 2/8/05
241-Z Treatment and Storage Tanks	Rev. 8B	Rev. 8B	Closed, 2/22/07
303-M Oxide Facility	Rev. 8B	Rev. 8B	Closed, 6/15/06
224-T Transuranic Waste Storage and Assay Facility	Rev. 8C	Rev. 8C	Closed, 11/12/08
FS-1 Outdoor Container Storage Area Closure	Rev. 8C	Rev.8C	Closed, 10/25/16
Waste Encapsulation and Storage Facility Hot Cells A through F	Rev. 8C		
207-A South Retention Basins	Rev. 8C	Rev. 8C	Closed, 05/18/17
1706 KE Waste Treatment System	Rev. 8C	Rev. 8C	Closed, 1/11/18
600 Area Purgewater Storage and Treatment Facility	Rev. 8C	Rev. 8C	Closed, 02/16/18
PUREX Storage Tunnels	Rev. 8C		Unit group requirements were moved from Part III to Part V Revision 8C (8C.2019.5F, 12/17/18).
276-BA Storage Area	Rev. 8C		
Part VI, Postclosure Units			
183-H Solar Evaporation Basin	Rev. 4		
300 Area Process Trenches	Rev. 3		
Procedurally Closed			

II.Z.1.b The proposed method of treatment, storage or disposal is that practicable method currently available to the Permittee, which minimizes the present and future threat to human health and the environment.

II.Z.2 The Permittee will maintain each such certification of waste minimization in the operating record as required by Permit Condition II.I.1.

II.AA Air Emission Standards for Process Vents

The Permittees will comply with applicable requirements of WAC 173-303-690 for process vents associated with Part III units performing specific separations processes unless exempted by WAC 173-303-690(1)(d). Threshold limits applied to process vents potentially requiring emission controls subject to WAC 173-303-690 are evaluated based on the summation of applicable emission sources for the entire Hanford Facility. When the summed emissions fall below threshold limits in 40 CFR 264.1032(a)(1), no emission control devices are required. If threshold limits in 40 CFR 264.1032(a)(1) are predicted to be exceeded, the Permittees will notify Ecology to determine the appropriate course of action. Unit-specific information is contained in Part III of the Permit for applicable units.

II.BB Air Emission Standards for Equipment Leaks

The Permittees will comply with applicable requirements of WAC 173-303-691 for certain equipment leaks associated with Part III units unless exempted by WAC 173-303-691(1)(e) or (f). Air emission standards apply to equipment that contacts or contains hazardous wastes with organic concentrations of at least 10 percent by weight. Unit-specific information is contained in Part III of the Permit for applicable units.

II.CC Air Emission Standards for Tanks, Surface Impoundments, and Containers

The Permittees shall comply with applicable requirements of WAC 173-303-692 for containers, tanks, and surface impoundment areas associated with Part III units unless exempted by WAC 173-303-692(1)(b). Unit-specific information is contained in Part III of the Permit for applicable units.

PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

~~Operating Unit 2, PUREX Storage Tunnels~~

Operating Unit 3, Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility

Operating Unit 4, 242-A Evaporator

Operating Unit 5, 325 Hazardous Waste Treatment Units

Operating Unit 10, Waste Treatment and Immobilization Plant

Operating Unit 11, Integrated Disposal Facility

Operating Unit 16, 400 Area Waste Management Unit

Operating Unit 19, Capsule Interim Storage

PART IV UNIT SPECIFIC CONDITIONS FOR CORRECTIVE ACTION

Corrective Action Unit 1, 100-NR-1

PART V UNIT-SPECIFIC CONDITIONS FOR UNITS UNDERGOING CLOSURE

Closure Unit 6, Waste Encapsulation and Storage Facility Hot Cells A through F

Closure Unit 25, PUREX Storage Tunnels

Closure Unit 32, 276-BA Organic Storage Area

PART VI UNIT-SPECIFIC CONDITIONS FOR UNITS IN POST-CLOSURE

Post Closure Unit 1, 300 Area Process Trenches

Post Closure Unit 2, 183-H Solar Evaporation Basins

UNITS RETIRED FROM THE PERMIT

100 D Ponds (Closed 8/9/99)

105-DR Large Sodium Fire Facility (Closed 7/1/04)

100-NR-2 Operable Unit (9/30/09)

200 West Area Ash Pit Demolition Site (Closed 11/28/95)

2101-M Pond (Closed 11/28/95)

216-B-3 Expansion Ponds (Closed 7/31/95)

218-E-8 Borrow Pit Demolition Site (Closed 11/28/95)

224-T Transuranic Waste Storage and Assay Facility (Closed 11/12/08)

241-Z Treatment and Storage Tanks (Closed 2/22/07)

2727-S Nonradioactive Dangerous Waste Storage Facility (Closed 7/31/95)

300 Area Solvent Evaporator (Closed 7/31/95)

300 Area Waste Acid Treatment System (Closed 10/30/2005)

303-K Storage Facility (Closed 7/22/02)

303-M Oxide Facility (Closed 6/15/06)

304 Concretion Facility (Closed 1/21/96)

305-B Storage Facility (Closed 7/2/07)

3718-F Alkali Metal Treatment and Storage Facility Closure Plan (Closed 8/4/98)

4843 Alkali Metal Storage Facility Closure Plan (Closed 4/14/97)

Hanford Patrol Academy Demolition Site (Closed 11/28/95)

Plutonium Finishing Plant Treatment Unit (Closed 2/8/05)

Simulated High Level Waste Slurry Treatment and Storage Unit (Closed 10/23/95)

FS-1 Outdoor Container Storage Area (Closed 10/25/2016)

616 Non-Radioactive Dangerous Waste Storage Facility (Closed 9/5/01)

331-C Storage Unit (Closed 7/22/11)

207-A South Retention Basin (Closed 5/18/17)

1324-N Surface Impoundment & 1324-NA Percolation Pond (Closed 4/25/2017)

1706-KE Waste Treatment System Facility (Closed 1/11/18)

600 Area Purgewater Storage and Treatment Facility (Closed 2/16/18)

1301-N Liquid Waste Disposal Facility (Closed 11/28/18)

Hanford Facility RCRA Permit Change Notice

Part III, Operating Unit Group 3

Liquid Effluent Retention Facility & 200 Area Effluent Treatment Facility

Index

Submitted by WRPS Co-Operator:

6/23/20

Jeremy T. Hartley — Date

Reviewed by DOE-ORP Program Office:

Brian A. Harkins Digitally signed by Brian A. Harkins Date: 2020.06.23 14:03:58 -07'00'

Rob G. Hastings — Date

Hanford Facility RCRA Permit Change Notice	
Unit: **Liquid Effluent Retention Facility & 200 Area Effluent Treatment Facility**	Permit Part **Part III, Operating Unit Group 3**

Description of Modification:

Part III, Operating Unit Group 3 Permit Conditions:

Update the following List of Addenda Specific to Operating Unit Group 3 with modification approval date:

Addendum C Process Information, dated TBD ~~May 19, 2020~~

WAC 173-303-830 Modification Class	Class 1	Class '1	Class 2	Class 3
Please mark the Modification Class:		X		

Enter relevant WAC 173-303-830, Appendix I Modification citation number: WAC 173-303-830(4)(d)(i)

Enter wording of WAC 173-303-830, Appendix I Modification citation: Request modification be reviewed and approved as a Class 1 prime modification.

Modification Concurrence:	Reviewed by Ecology:
Modification Concurrence: ☒ Yes ☐ No (state reason) Reason for Non-concurrence:	Schleif, Stephanie (ECY) Digitally signed by Schleif, Stephanie (ECY) Date: 2020.06.25 13:31:52 -07'00' Stephanie Schleif — Date

Hanford Facility RCRA Permit Change Notice

Unit:	Permit Part
Liquid Effluent Retention Facility & 200 Area Effluent Treatment Facility	**Part III, Operating Unit Group 3**

Description of Modification:

Addendum C, Process Information:

Modifications pertain to:

- Section C.2.4, Concentrate Staging: Updated text to reflect each concentrate tank has a pair of heat exchangers, rather than one. Reference supporting information drawing H-2-88988, Sheet 2.
- Section C.4.1, Design Requirements: Updated hydrogen peroxide decomposer vessels material of construction to 316 stainless steel.
- Table C-8, Peroxide Decomposer, H2O2 Decomposers (2) updated material of construction for 60D-CO-1A/-1B to 316 stainless steel.
- Table C-8, Concentrate Tanks, updated number of Concentrate heat exchangers to four and updated corresponding equipment ID numbers:

WAC 173-303-830 Modification Class	Class 1	Class '1	Class 2	Class 3
Please mark the Modification Class:		X		

Enter relevant WAC 173-303-830, Appendix I Modification citation number: WAC 173-303-830(4)(d)(i)

Enter wording of WAC 173-303-830, Appendix I Modification citation: Request modification be reviewed and approved as a Class 1 prime modification.

Modification Approved: [X] Yes [ ] No (state reason)

Reason for Non-concurrence: Approved with Ecology's Changes (See Table C-8)

Reviewed by Ecology:

Schleif, Stephanie (ECY) Digitally signed by Schleif, Stephanie (ECY) Date: 2020.06.25 13:32:24 -07'00'

Stephanie Schleif | Date

Replace the Following:

- Part III, LERF and 200 Area ETF Permit Conditions
- Addendum C, Process Information

Supporting Information

- H-2-88988-2, Rev. 1, Concentrate Receiving Sys Heat Exchanger

PART III, OPERATING UNIT GROUP 3 PERMIT CONDITIONS
LIQUID EFFLUENT RETENTION FACILITY &
200 AREA EFFLUENT TREATMENT FACILITY

UNIT DESCRIPTION

The Liquid Effluent Retention Facility (LERF) and 200 Area Effluent Treatment Facility (200 Area ETF) consists of an aqueous waste treatment system that provides treatment, storage integral to the treatment process, and storage of secondary wastes from the treatment process for a variety of aqueous mixed waste. The 200 Area ETF is located in the 200 East Area. Aqueous wastes managed by the 200 Area ETF include process condensate from the LERF and 200 Area ETF and other aqueous waste generated from onsite remediation and waste management activities.

The LERF consists of three lined surface impoundments, or basins. Aqueous waste from LERF is pumped to the 200 Area ETF for treatment in a series of process units, or systems, that remove or destroy essentially all of the dangerous waste constituents. The treated effluent is discharged to a State-Approved Land Disposal Site (SALDS) north of the 200 West Area, under the authority of a Washington State Waste Discharge Permit Number ST0004500 (Ecology 2014) and 200 Area ETF Delisting (40 Code of Federal Regulations [CFR] 261, Appendix IX, Table 2). Construction of the LERF began in 1990. Waste management operations began at LERF in April 1994. Construction of the 200 Area ETF began in 1992. Waste management operations began at 200 Area ETF in November of 1995.

This Chapter provides unit-specific Permit conditions applicable to the dangerous waste management units for LERF and 200 Area ETF.

LIST OF ADDENDA SPECIFIC TO OPERATING UNIT GROUP 3

Addendum A	Part A Form, dated May 19, 2020
Addendum B	Waste Analysis Plan, dated May 19, 2020
Addendum C	Process Information, dated TBD~~May 19, 2020~~
Addendum D	Groundwater Monitoring, dated January 23, 2018
Addendum E	Security Requirements, dated June 30, 2011
Addendum F	Preparedness and Prevention, dated May 19, 2020
Addendum G	Personnel Training, dated June 30, 2015
Addendum H	Closure Plan, dated May 19, 2020
Addendum I	Inspection Requirements, dated May 19, 2020
Addendum J	Contingency Plan, dated April 30, 2019

DEFINITIONS

Flow Equalization: Flow equalization is the process by which concentrations of constituents are homogenized through blending of the wastewater in the LERF Basins, resulting in a more uniform loading of constituents prior to entering the appropriate treatment train.

State and Federal Delisting Actions: The state delisting action pursuant to Washington Administrative Code (WAC) 173-303-910(3), August 8, 2005, and the federal delisting action appearing in 40 CFR 261, Appendix IX, Table 2 applicable to the United States, Department of Energy, Richland, Washington.

ACRONYMS

LERF and 200 Area ETF	200-Area Liquids Processing Facility

C.2.4 Secondary Treatment Train

The secondary treatment system typically receives and processes the following by-products generated from the primary treatment train: concentrate from the first RO stage, filter backwash, regeneration waste from the IX system, and spillage or overflow received into the process sumps. Depending on the operating configuration; however, some aqueous waste could be processed in the secondary treatment train before the primary treatment train (refer to Figures C-4 and C-5 for example operating configurations).

The secondary treatment train provides the following processes:

- Secondary waste receiving - tank receiving and chemical addition.
- Evaporation - concentrates secondary waste streams.
- Concentrate staging - concentrate (brine) receipt, pH adjustment, and chemical addition.
- Brine loadout system - transfers brine waste into containers (totes).
- Thin film drying - dewatering of secondary waste streams.
- Container handling - packaging of dewatered secondary waste.

Secondary Waste Receiving. Waste to be processed in the secondary treatment train is received into two secondary waste receiving tanks, where the pH can be adjusted with sulfuric acid or sodium hydroxide for optimum evaporator performance. Chemicals, such as reducing agents, may be added to waste in the secondary waste receiving tanks to reduce the toxicity or mobility of constituents in the powder.

Evaporation. The Evaporator Vapor Body Vessel (60I-EV-1) is fed alternately by the two secondary waste receiving tanks. One tank serves as a waste receiver while the other tank is operated as the feed tank. The Evaporator Vapor Body Vessel (also referred to as the vapor body) is the principal component of the evaporation process (Figure C-11).

Feed from the secondary waste receiving tanks is pumped through a heater to the recirculation loop of the 200 Area ETF Evaporator. In this loop, concentrated waste is recirculated from the Evaporator Vapor Body Vessel, to a heater, and back into the evaporator where vaporization occurs. As water leaves the evaporator system in the vapor phase, the concentration of the waste in the evaporator increases. When the concentration of the waste reaches the appropriate density, a portion of the concentrate (brine) is pumped to one of the concentrate tanks.

The vapor that is released from the Evaporator Vapor Body Vessel is routed to the entrainment separator, where water droplets and/or particulates are separated from the vapor. The “cleaned” vapor is routed to the vapor compressor and converted to steam.

The steam from the vapor compressor is sent to the heater (reboiler) and used to heat the recirculating concentrate in the Evaporator Vapor Body Vessel. From the heater, the steam is condensed and fed to the distillate flash tank, where the saturated condensate received from the heater drops to atmospheric pressure and cools to the normal boiling point through partial flashing (rapid vaporization caused by a pressure reduction). The resulting distillate is routed to the surge tank. The non-condensable vapors, such as air, are vented through a vent gas cooler to the vessel off gas system.

Concentrate Staging. The concentrate tanks are upstream of the thin film drying process. From the Evaporator Vapor Body Vessel, concentrate (e.g. brine) is pumped into two concentrate tanks, and pH adjusted chemicals, such as reducing agents, may be added to reduce the toxicity or mobility of constituents as a brine, or when converted to powder. Excess heat is removed from the concentrate waste by ~~a~~ water-cooled heat exchangers. Each concentrate tank has a pair of heat exchangers installed in the concentrate recirculation line (see Drawing H-2-88988, Sheet 1 and 2). The cooling water is a closed recirculation loop to the cooling tower.

The specifications for the preparation, design, and construction of the tank systems at the 200 Area ETF are documented in the *Design Construction Specification, Project C-018H, 242-A Evaporator/PUREX Plant Process Condensate Treatment Facility* (V-C018HC1-001, WHC 1992). The preparation, design, and construction of Load-In Station tanks 59A-TK-109 and 59A-TK-117 are provided in the construction specifications in *Project W-291, 200 Area Effluent BAT/AKART Implementation ETF Truck Load-in Facility, Construction Specifications* (*W-291H-C2*, KEH 1994). The preparation, design, and construction of Load-In Station tank 59A-TK-1 are documented in *Purgewater Unloading Facility Project Documentation* (HNF-39966, 2009).

Most of the tanks in the 200 Area ETF are constructed of stainless steel. According to the design of the 200 Area ETF, it was determined stainless steel would provide adequate corrosion protection for these tanks. Exceptions include Load-In Station tank 59A-TK-1, which is constructed of fiberglass-reinforced plastic and the verification tanks, which are constructed of carbon steel with an epoxy coating. The Evaporator Vapor Body Vessel (and the internal surfaces of the thin film dryer) is constructed of a corrosion resistant alloy, known as alloy 625, to address the specific corrosion concerns in the secondary treatment train. Finally, the hydrogen peroxide decomposer vessels are constructed of 316 stainless steel~~carbon steel and coated with a vinyl ester lining~~.

The shell thicknesses of the tanks identified in Table C-6 represent a nominal thickness of a new tank when placed into operation. The tank capacities identified in this table represent the maximum volumes. Nominal tank volumes discussed below represent the maximum volume in a tank unit during normal operations.

C.4.1.1 Codes and Standards for Tank System Construction

Specific standards for the manufacture of tanks and process systems installed in the 200 Area ETF are briefly discussed in the following sections. In addition to these codes and industrial standards, a seismic analysis for each tank and process system is required [WAC 173-303-806(4)(a)(xi)]. The seismic analysis was performed in accordance with UCRL-15910 *Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards*, Section 4 (UCRL 1987). The results of the seismic analyses are summarized in the engineering assessment of the 200 Area ETF tank systems (*Final RCRA Information Needs Report*, Mausshardt 1995).

Storage and Treatment Tanks. The following tanks store and/or treat dangerous waste at the 200 Area ETF.

Tank Name	Tank Number
Surge tank	60A-TK-1
pH adjustment tank	60C-TK-1
Effluent pH adjustment tank	60C-TK-2
First RO feed tank	60F-TK-1
Second RO feed tank	60F-TK-2
Verification tanks (three)	60H-TK-1A/1B/1C
Secondary waste receiving tanks (two)	60I-TK-1A/1B
Evaporator Vapor Body Vessel	601-EV-1
Concentrate tanks (two)	60J-TK-1A/60J-TK-1B
Sump tanks (two)	20B-TK-1/2
Distillate flash tank	60I-TK-2
Load-In Station tank	59A-TK-1
Load-In Station Sump Tanks	59A-TK-2/59A-TK-3

Table C-7 200 Area Effluent Treatment Facility Additional Tank System Information

Tank Description	Liner Material	Pressure Control	Foundation Material	Structural Support	Seam	Connection
Distillate Flash Tank 60I-TK-2	None	Pressure Relief Valve/Vent to Vent Gas Cooler/VOG	Concrete Slab	Carbon Steel I-Beam and Cradle	Welded	Flanged
Sump Tank 1 20B-TK-l	None	Vent to VOG	Concrete Containment	Reinforced Concrete Containment Basin	Welded	Flanged
Sump Tank 2 20B-TK-2	None	Vent to VOG	Concrete Containment	Reinforced Concrete Containment Basin	Welded	Flanged

DFT = distillate flash tank

VOG = vessel off gas system

Table C-8 Ancillary Equipment and Material Data

System	Ancillary Equipment	Number	Material
Load-In Station Tank	Load-In Station/Transfer Pumps (2)	P-103A/-103B	316 SS
		P-001A/-001B	Cast Iron
	Load-In Station Filters (6)	59A-FL-001/-002/-003/-004/-005/-006	304 SS
Load-In Filter Sump Tanks 59A-TK-2/59A-TK-3	Transfer pumps (2)	59A-P-2/59A-P-3	Cast Iron/SS
	59A-TK-2 level switch	59A-P-2 (level switch part of pump assembly)	PVC
	59A-TK-3 level gauge	LI-59A-303	SS
Surge Tank	Surge Tank Pumps (3)	60A-P-1A/-1B/-1C	CS with ETFE coating
Rough Filter	Rough Filter	60B-FL-1	304 SS
UV/OX	UV Oxidation Inlet Cooler	60B-E-1	316 SS
	UV Oxidizers (4)	60D-UV-1A/-1B/-2A/-2B	316 SS
pH Adjustment	pH Adjustment Pumps (2)	60C-P-1A/-1B	304 SS
Peroxide Decomposer	H2O2 Decomposers (2)	60D-CO-1A/-1B	316 SS~~CS with Epoxy Coating~~
Fine Filter	Fine Filter	60B-FL-2	304 SS
Degasification	Degasification Column Inlet Cooler	60E-E-1	316 SS
	Degasification Column	60E-CO-1	FRP
	Degasification Pumps (2)	60E-P-1A/-1B	316 SS

Table C-8 Ancillary Equipment and Material Data

System	Ancillary Equipment	Number	Material
	Concentrate heat exchanger ~~(2)~~ (4) Ecology's Changes	60J-E-02A 60J-E-02B 60J-E-03A 60J-E-03B	316L SS
Brine loadout system	Tote fill lid	N/A	Plastic/316 SS
	Inline flowmeter	60J-333	SS/ETFE liner
	Automatic shutoff valve	60J-334/60J-335	316 SS
Thin Film Dryer	Concentrate Feed Pump	60J-P-2	316 SS
	Thin Film Dryer	60J-D-1	Interior Surfaces: Alloy 625 Rotor and Blades: 316 SS
	Powder Hopper	60J-H-1	316 SS
	Spray Condenser	60J-DE-01	316 SS
	Distillate Condenser	60J-CND-01	Tubes: 304 SS Shell: CS
	Dryer Distillate Pump	60J-P-3	316 SS
Resin Dewatering	Portable Pump	60G-P-1	Plastic

ETFE = ethylene tetrafluoroethylene. ETFE is a Teflon product.

Table C-9 Concrete and Masonry Coatings

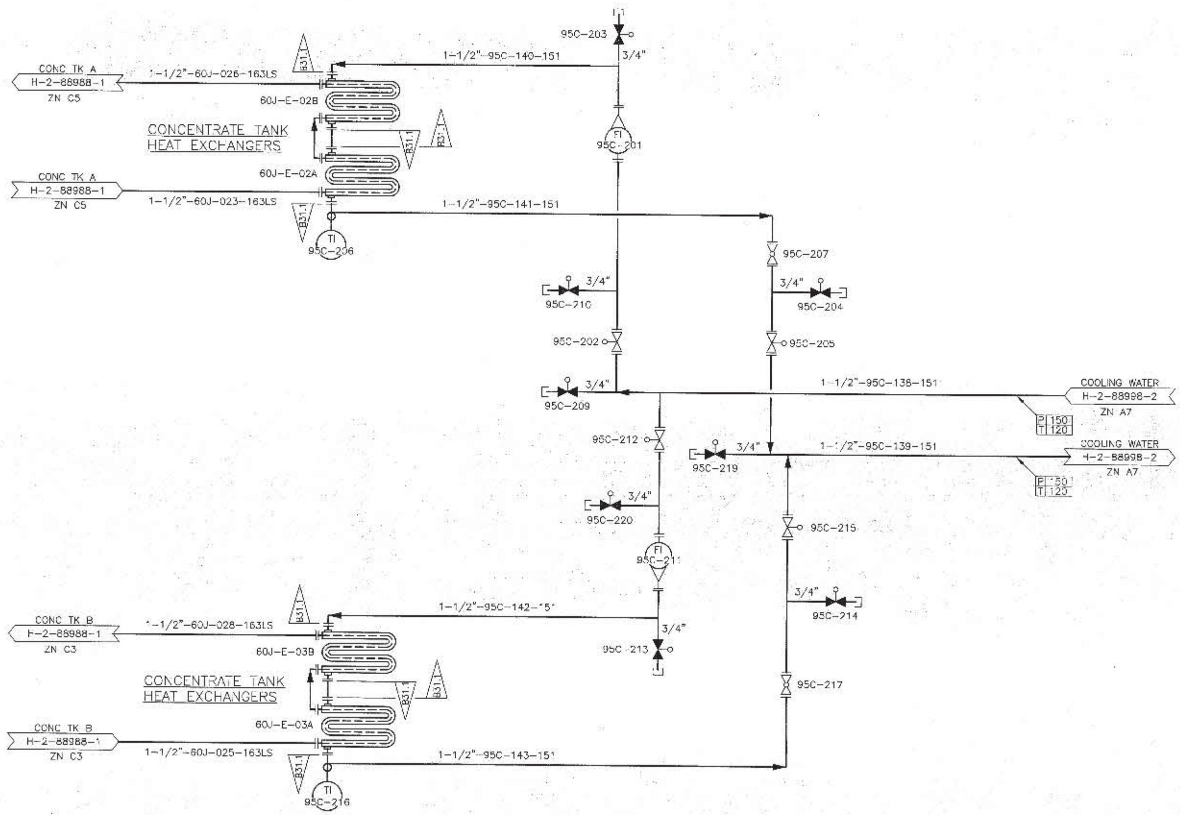
Location	Product Name	Applied Film Thickness, Estimated
		Mils
2025E Process Area, Truck Bay, and Container Storage Area		
Floor: Topcoat	Chemproof PermaCoat 4000[1]	2 coats at 12-16 mils
Walls to 7 feet, Doors & Jambs	Chemproof PermaCoat 4000 Vertical[1]	2 coats at 12-16 mils
2025ED Load-In Station Tank Pit		
Floor and Walls Topcoat	Elasti Liner I/II[2,3]	80 mils
Floor and Walls: Primer	Techni-Plus E[2]	5.0-7.0 mils
Surge Tank and Verification Tank Berms		
Floors (and Walls at Surge Tank): Topcoat	Elasti-Liner I[2]	80 mils
Floors (and Walls at Surge Tank): Primer	Techni-Plus E3[2]	5.0-7.0 mils

[1]PermaCoat is a trademark of Chemproof Polymers, Inc.

[2]Elasti-Liner and Techni-Plus are trademarks of KCC Corrosion Control, Inc.

NOTES:

1. SEE H-2-89351 SH 1 FOR LEGEND AND ABBREVIATIONS.
2. PIPING CATEGORY:
   60J CONCENTRATE PIPING – ASME B31.3
   95C COOLING WATER PIPING – ASME B31.1
3. AN IDENTIFICATION TAG SHALL BE SUPPLIED AND ATTACHED WITH STAINLESS STEEL WIRE TO THE VALVES AND COMPONENTS. 1/4" STAMPED OR ENGRAVED CHARACTERS SHALL BE USED ON A STAINLESS STEEL TAG PER TFC-ENG-STD-12. THE TAG SHALL INCLUDE THE EQUIPMENT IDENTIFICATION NUMBER (EIN) AS IDENTIFIED ON THE P&ID.



5/28/20

6/28/20

DWG NUMBER	TITLE
DRAWING TRACEABILITY LIST	

REF NUMBER	TITLE
H-2-538175	DRAWING LIST/TITLE SHEET
REFERENCES	
NEXT USED ON SHEET 1	

REV NO	DESCRIPTION
1	DIRECT REVISION PER ED1-882569
REVISIONS	

BLDG NO 2025E

INDEX NO 7004

CAUTION: NOT COMPLETE WITHOUT CURRENT CHANGE DOCUMENTS FROM DATABASE

NAME
F. CHAVEZ
V. F. SALYERS
N. W. NELSON
C. S. OLSON

U.S. DEPARTMENT OF ENERGY
Office of River Protection

P & ID
CONCENTRATE RECEIVING SYS
HEAT EXCHANGER

SIZE F | DRAWING NUMBER H-2-88988 | SHEET 2 | REV 01

SCALE NONE

29017

Hanford Facility RCRA Permit Modification Notification Forms

Part III, Operating Unit 5

325 Hazardous Waste Treatment Units

Index

Submitted by Co-Operator:

Cameron M Andersen Digitally signed by Cameron M Andersen Date: 2020.04.24 09:14:29 -07'00'

Cameron M. Andersen Date

Reviewed by DOE Program Office:

Duane Carter Digitally signed by Duane Carter Date: 2020.04.27 08:18:06 -07'00'

Duane B. Carter Date

Hanford Facility RCRA Permit Modification Form

Unit:	Permit Part
325 Hazardous Waste Treatment Units	***Part III, Operating Unit Group 5***

Description of Modification:

Conditions Page 3:

Revise "LIST OF ADDENDA SPECIFIC TO OPERATING UNIT GROUP 5" to reflect the modification date history:

LIST OF ADDENDA SPECIFIC TO OPERATING UNIT GROUP 5

Addendum A	Part A Form, dated August 2015
Addendum B	Waste Analysis Plan, dated May 2014
Addendum C	Process Information, dated May 2014
Addendum D	Groundwater Monitoring, (Reserved)
Addendum E	Procedures to Prevent Hazards, dated May 2014
Addendum F	Preparedness and Prevention, dated May 2014
Addendum G	Personnel Training, dated March 2017
Addendum H	Closure Plan, dated March 2016
Addendum I	Inspection Requirements, dated May 2014
Addendum J	Contingency Plan, dated ~~December 2019~~TBD
Attachment to Addendum J	Building Emergency Procedure Applicability Matrix, dated June 2019

WAC 173-303-830 Modification Class	Class 1	Class ¹1	Class 2	Class 3
Please mark the Modification Class:	X			

Enter relevant WAC 173-303-830, Appendix I Modification citation number:
A.1. Administrative and Informational changes

Modification Concurrence: X Yes ☐ No

Reviewed by Ecology:

Schleif, Stephanie (ECY) Digitally signed by Schleif, Stephanie (ECY) Date: 2020.05.05 09:49:03 -07'00'

S. N. Schleif   Date

Hanford Facility RCRA Permit Modification Form	
Unit: *325 Hazardous Waste Treatment Units*	Permit Part *Part III, Operating Unit Group 5*

Description of Modification:

Addendum J, Contingency Plan

Replace 325 Building Emergency Procedure in Addendum J with Revision 23 dated April 10, 2020. See attached redline/strikeout for specific changes.

NOTE: The Attachment 1 changes relate to a drawing. The component changes to the drawing are not amenable to redline/strikeout format. Therefore, the component changes to the drawing are described below:

Attachment 1 drawing change description:
The drawing is being changed to more accurately show the Room 201 Central Accumulation Area location, i.e. inside the hot cells instead of the whole room.

WAC 173-303-830 Modification Class	Class 1	Class '1	Class 2	Class 3
Please mark the Modification Class:	X			

Enter relevant WAC 173-303-830, Appendix I Modification citation number:
A.1. Administrative and Informational changes

Modification Concurrence: [X] Yes [ ] No

Reviewed by Ecology:

Schleif, Stephanie (ECY) Digitally signed by Schleif, Stephanie (ECY) Date: 2020.05.05 09:48:24 -07'00'

S. N. Schleif Date

Revision Instructions:

Revise the OUG-5 unit-specific permit conditions as shown herein.

Replace OUG-5 Contingency Plan (Rev 22.1) with Rev 23.

Quarter Ending Sept 30, 2019

24590-LAW-PCN-ENV-19-005

Hanford Facility RCRA Permit Modification Notification Form
Part III, Operating Unit 10
Waste Treatment and Immobilization Plant

Index

Replace the Corrosion Evaluations for the Low-Activity Waste (LAW) Concentrate Receipt Vessels (LCP-VSL-00001 and -00002), Melter Feed Preparation Vessels (LFP-VSL-00001 and -00003), Melter Feed Vessels (LFP-VSL-00002 and -00004), Melter Submerged Bed Scrubbers (SBS) (LOP-SCB-00001 and -00002) and Melter SBS Condensate Vessels (LOP-VSL-00001 and -00002) in Appendix 9.9 of the Dangerous Waste Permit (DWP).

Submitted by Co-Operator:

Robert D. Haggard 6/13/19
Date

Reviewed by ORP Program Office:

Thomas W. Fletcher 7/8/19
Date

Quarter Ending Sept 30, 2019 24590-LAW-PCN-ENV-19-005

Hanford Facility RCRA Permit Modification Notification Form	
Unit: **Waste Treatment and Immobilization Plant**	Permit Part: **Part III, Operating Unit 10**

Description of Modification:

The purpose of this Class 1 prime modification is to update and replace the following corrosion evaluations in Appendix 9.9 of the DWP:

Appendix 9.9			
Replace:	24590-LAW-N1D-LCP-P0001, Rev. 1	With:	24590-LAW-N1D-LCP-00001, Rev. 6
Replace:	24590-LAW-N1D-LFP-00004, Rev. 2	With:	24590-LAW-N1D-LFP-00004, Rev. 5
Replace:	24590-LAW-N1D-LFP-00006, Rev. 0	With:	24590-LAW-N1D-LFP-00006, Rev. 3
Replace:	24590-LAW-N1D-LOP-P0001, Rev. 1	With:	24590-LAW-N1D-LOP-00001, Rev. 4
Replace:	24590-LAW-N1D-LOP-P0002, Rev. 1	With:	24590-LAW-N1D-LOP-00002, Rev. 6

This modification requests Ecology approval and incorporation into the permit the specific changes to the listed corrosion evaluations. These documents include changes provided in applicable document change forms (e.g., DCN, SCN, SDDR, FCN, FCR, etc.). In addition, the corrosion evaluations include changes associated with the resolution to comments on change documents since the issuance of the last revision of the permitted documents.

Significant changes to the corrosion evaluations are summarized below:

- Revised the corrosion evaluations completely by implementing the new document format
- Updated the information in the Materials Considered, Recommended Material, and Corrosion/Erosion Detailed Discussion sections and the Process Corrosion Data Sheet (PCDS) where applicable (24590-LAW-N1D-LFP-00004, 24590-LAW-N1D-LFP-00006, 24590-LAW-N1D-LOP-00001, and 24590-LAW-N1D-LOP-00002)
- Revised the Description of Vessel/Equipment and Description of Process Functions sections
- Revised the Materials Localized Corrosion Design Limits table for clarification of previously blacked out entries
- Revised Corrosion Evaluation and Process Corrosion Data Sheet (PCDS) where appropriate to describe DFLAW configuration and return of off-spec materials (24590-LAW-N1D-LCP-00001, 24590-LAW-N1D-LFP-00004, and 24590-LAW-N1D-LFP-00006)
- Replaced reference to 24590-WTP-RPT-M-11-002, *WTP Materials Localized Corrosion Design Limits,* with 24590-WTP-DB-ENG-01-001, *Basis of Design* throughout
- Revised Inputs and References and Corrosion/Erosion Detailed discussions to update operating temperatures, pH, and solids information to reflected calculation changes/updates
- Revised to include pages that were not included with issued document due to scanning error
- Updated References and Bibliography to add and re-number references to reflect changes described above
- Where appropriate replaced Permit versions of Corrosion Evaluations with latest Source versions of Corrosion Evaluations (24590-LAW-N1D-LCP-00001, 24590-LAW-N1D-LOP-00001, and 24590-LAW-N1D-LOP-00002)
- Throughout 24590-LAW-N1D-LOP-00002 replaced reference to 24590-WTP-M0E-50-00012 with 24590-WTP-M0E-50-00023

In accordance with Permit Condition III.10.C.2.e, this permit modification sent to Ecology includes the following redline page changes:

- ~~Permit Condition Table III.10.E.B~~
- Permit Condition Table III.10.H.A

Quarter Ending Sept 30, 2019 24590-LAW-PCN-ENV-19-005

WAC 173-303-830 Modification Class:	Class 1	Class [1]1	Class 2	Class 3
Please mark the Modification Class:		X		

Enter relevant WAC 173-303-830, Appendix I Modification citation number:

Enter wording of WAC 173-303-830, Appendix I Modification citation:

In accordance with WAC 173-303-830(4)(d)(i), this modification notification is requested to be reviewed and approved as a Class [1]1 modification. WAC 173-303-830(4)(d)(ii)(A) states, "Class 1 modifications apply to minor changes that keep the permit current with routine changes to the facility or its operation. These changes do not substantially alter the permit conditions or reduce the capacity of the facility to protect human health or the environment. In the case of Class 1 modifications, the director may require prior approval."

Modification Approved/Concur: [X] Yes [ ] Denied (state reason below)	Reviewed by Ecology:
Reason for denial:	~~S. Dahl~~ 4/8/2020 Date

CORROSION EVALUATION

LCP-VSL-00001 & LCP-VSL-00002
Concentrate Receipt Vessel

Appurtenances
LCP-AGT-00001 – LCP-AGT-00002

Contents of this document are Dangerous Waste Permit affecting

Results

Materials Considered:

Material (UNS No.)	Acceptable Material
Type 304L (S30403)	X (support only)
Type 316L (S31603)	X
Al-6XN® 6% Mo (N08367)	X
Hastelloy® C-22® (N06022)	X
ULTIMET® alloy (R31233)	X (agitator impeller only)

Recommended Material Types: **Vessel head/shell – Type 316 (max 0.030% C; dual certified)**
Vessel support – Type 304 or 316 (max 0.030% C; dual certified)
Agitator shaft – Type 316 (max 0.030% C; dual certified)
Agitator impeller – ULTIMET®

Minimum Corrosion Allowance: **0.040 inch (includes 0.024 inch corrosion allowance and 0.016 inch general erosion allowance)**

Inputs and References

- Operating temperature (°F) (nom/max): 123/140 (24590-LAW-MVC-LCP-00002)
- Maximum solids: 3.4 wt% (24590-LAW-MVC-LCP-00002)
- Uniform corrosion allowance (inch): 0.024 (24590-WTP-DB-ENG-01-001)
- Uniform erosion allowance (inch): 0.016 (24590-WTP-DB-ENG-01-001)
- Design corrosion allowance (inch): 0.040 (24590-WTP-M0C-50-00004)
- Location: Process cells; Rooms L-0123, L-0124 (24590-LAW-P1-P01T-00002)
- Operating conditions are as stated in the applicable section of *WTP Process Corrosion Data – Volume 4* (24590-WTP-RPT-PR-04-0001-04)

Assumptions and Justification (refer to Section 19—References)

- Source data presented on the Process Corrosion Datasheet (PCDS) are conservative with respect to corrosion.[10]
- LCP-VSL-00001 and LCP-VSL-00002 are interchangeable and can transfer treated LAW concentrate to and from each other. This is done to allow flexibility in the Plant so each of the melter trains can be utilized and is considered an off-normal event.[10]
- Solids concentration used for erosion allowance is based on maximum value for stream LCP01.[3]
- The vessels are equipped with mechanical agitators designed for continuous operation. At minimum, the agitators are used to mix the vessel contents prior to and during sampling operations. Further, continuous agitation is used to maintain uniform vessel temperature preventing dissolved solids from dropping out of solution.[2]
- Operations using equipment located in the wet process cells and bulges are normally performed remotely. To facilitate periodic hands on maintenance for equipment in the wet process cell, the vessels are equipped with wash rings used for decontamination purposes. DIW and other utilities can be attached to the water supply line into the wet process cells for use during maintenance activities.[2] Use of other decontamination solutions through header connections to the spray nozzles is considered possible.

REV	DATE	REASON FOR REVISION	ORIGINATE	CHECK	REVIEW	APPROVE
6	3/29/19	Revised to include pages that were not included with issued document. No technical changes have been made from Rev 5 to Rev 6	Originator By: Dr. Robert Davis - rbdavis Org Name: Bechtel Placed: Feb 01, 2019 RBDavis	Checked By: - mfang Placed: Feb 06, 2019 MFang	REVIEWED By Rangus at 12:05 pm, 2/2/19 APRangus	JLJulyk

CORROSION EVALUATION

Operating Restrictions

- Develop procedure to bring the vessel contents to within the limits defined for Type 316L in 24590-WTP-DB-ENG-01-001, *Basis Of Design,* in the event that temperature, pH, or chloride concentration exceeds those limits.
- Develop a procedure to control, at a minimum, cleaning, rinsing, and flushing of vessel and internals, as applicable.
- Develop procedure to control lay-up and storage; includes both before plant is operational and during inactive periods after start-up.
- Procedures are to be reviewed and accepted by MET prior to use.

Concurrence _____TD___
Operations

CORROSION EVALUATION

REVISION HISTORY

5	11/14/18	Incorporate updated PCDS report Update references	DLAdler	MFang	RBDavis	JLJulyk
4	12/15/15	Extensive re-write-no rev bars shown New format Incorporate revised PCDS Update references	DLAdler	TRangus	RBDavis	TErwin
3	5/24/05	Update wear allowance based on 24590-WTP-RPT-M-04-0008	DLAdler	JRDivine	NA	APRangus
2	6/23/04	Incorporate new PCDS Add Section p – Inadvertent Addition of Nitric Acid	DLAdler	JRDivine	NA	APRangus
1	12/29/03	Update design temp/pressure Update number of vessels Update format Append updated MSDS Remove reference to open issues Re-format references Add DWP note	DLAdler	JRDivine	NA	APRangus
0	6/25/02	Initial Issue	DLAdler	JRDivine	SS	SMKirk
REV	**DATE**	**REASON FOR REVISION**	**ORIGINATE**	**CHECK**	**REVIEW**	**APPROVE**

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 15 sheets.

CORROSION EVALUATION

Corrosion/Erosion Detailed Discussion

The LAW Concentrate Receipt Process (LCP) system receives LAW concentrate from the Treated LAW Concentrate Storage Process (TCP) system or Direct LAW Feed from LAWPS and acts as a buffer/storage vessel for LAW feed sent to the LFP System. The treated LAW feed is transferred from LCP-VSL-00001/2 to the melter feed preparation vessels (LFP-VSL-00001/3) where it is mixed with glass formers in preparation of sending it to the LAW melters. LCP-VSL-00001 and LCP-VSL-00002 will have the same stream properties and henceforth they are collectively referred to as LCP-VSL-00001/2.

When the attached PCDS discusses transfers between these vessels and the Pretreatment Facility, those routes are blanked in DFLAW configuration; transfer routes to DFLAW are not available in baseline configuration.

1 General/Uniform Corrosion Analysis

a Background

General corrosion or uniform corrosion is corrosion that is distributed uniformly over the surface of a material without appreciable localization. This leads to relatively uniform thinning on sheet and plate materials and general thinning on one side or the other (or both) for pipe and tubing. It is recognized by a roughening of the surface and by the presence of corrosion products. The mechanism of the attack is an electrochemical process that takes place at the surface of the material. Differences in composition or orientation between small areas on the metal surface create anodes and cathodes that facilitate the corrosion process.

b Component-Specific Discussion

This vessel receives treated LAW concentrate exclusively. The normal pH, chloride concentration, and temperatures are such that both Type 304L and Type 316L stainless steel will be acceptable. The solution is constantly mixed using mechanical agitators and sampling is performed. The uniform corrosion rate is low under these conditions.

2 Pitting Corrosion Analysis

Pitting is localized corrosion of a metal surface that is confined to a point or small area and takes the form of cavities. Dillon (2000) is of the opinion that in alkaline solutions, pH>12, chlorides are likely to promote pitting only in tight crevices such as might form after partial removal of deposits during multiple rinse cycles. Dillon and Koch (1995) are both of the opinion that fluoride will have little effect in an alkaline media. Normally the vessel is to operate at 123 °F (140 °F max) at a nominal pH of 14.6.

The chemistry and operating conditions in this vessel fall within the limits established for 300 series stainless steel in Table 18-1 of 24590-WTP-ENG-01-001, *Basis of Design*. For convenience, this comparison is documented on page 7 of this corrosion evaluation.

3 Crevice Corrosion Analysis

Crevice corrosion is a form of localized corrosion of a metal or alloy surface at, or immediately adjacent to, an area that is shielded from full exposure to the environment because of close proximity of the metal or alloy to the surface of another material or an adjacent surface of the same metal or alloy. Crevice corrosion is similar to pitting in mechanism. It can, however, be initiated at lower temperatures.

Crevices in this vessel are limited by the design and fabrication practice. All welding uses butt welds, and crevices associated with vessel internals are minimal. With the stated operating conditions, either Type 304L or Type 316L is acceptable.

The chemistry and operating conditions in this vessel fall within the limits established for either Type 304L or Type 316L in Table 18-1 of 24590-WTP-ENG-01-001. For convenience, this comparison is documented on page 7 of this corrosion evaluation.

4 Stress Corrosion Cracking Analysis

Stress corrosion cracking (SCC) is the cracking of a material produced by the combined action of corrosion and sustained tensile stress (residual or applied). The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, and the environment; also, chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even concentrations as low as 10 ppm can lead to cracking under some conditions.

The chemistry and operating conditions in this vessel fall within the limits established for either Type 304L or Type 316L in Table 18-1 of 24590-WTP-ENG-01-001. For convenience, this comparison is documented on page 7 of this corrosion evaluation.

5 End Grain Corrosion Analysis

End grain corrosion is preferential corrosion which occurs along the worked direction of wrought stainless steels exposed to highly oxidizing acid conditions. End grain corrosion is exclusive to metallic product forms with exposed end grains from shearing or mechanical cutting. Such conditions are not present in these vessels; therefore, end grain corrosion is not a concern.

CORROSION EVALUATION

6 Weld Corrosion Analysis

The welds used in the fabrication will follow the WTP specifications and standards for quality workmanship. The materials selected for this fabrication are compatible with the weld filler metals and ASME/AWS practice. Using the welding practices specified for the project, there should not be gross micro-segregation, precipitation of secondary phases, formation of unmixed zones, or volatilization of the alloying elements that could lead to localized corrosion of the weld. The low carbon materials specified for WTP prevent base metal sensitization during welding. Controls on the cover gas, heat input, and interpass temperature limit the heat tint. Corrosion at welds is not considered a problem in the proposed environment. No additional allowance is made for weld bead corrosion.

7 Microbiologically Influenced Corrosion Analysis

Microbiologically influenced corrosion (MIC) refers to corrosion affected by the presence or activity, or both, of microorganisms. Typically, with the exception of cooling water systems, MIC is not observed in operating systems. The proposed operating conditions are not conducive to microbial growth. Rinsing with untreated process water may be a concern; rinsing with demineralized water is recommended.

Conditions that lead to MIC are not present in this system.

8 Fatigue/Corrosion Fatigue Analysis

Fatigue is the process of progressive localized permanent structural change occurring in a material subjected to fluctuating stresses at less than the ultimate tensile strength of the material. Corrosion fatigue is the process wherein a metal fractures prematurely under conditions of simultaneous corrosion and repeated cyclic loading at lower stress levels or fewer cycles than would be required to cause fatigue of that metal in the absence of the corrosive environment. Based on the anticipated low mechanical and thermal cycling (24590-WTP-MVC-50-00009, *LAW, BOF, and LAB Vessel Cyclic Datasheet Inputs*, Attachment C), it can be stated that conditions which lead to fatigue or corrosion fatigue are not present in this vessel.

9 Vapor Phase Corrosion Analysis

Conditions in the vapor phase and at the vapor/liquid interface can be significantly different than those present in the liquid phase. The vapor space corrosion is self-limiting due to the passive film. Also, the layers of deposited corrosion product on top of the passive film act as barriers that reduce mass transport necessary for corrosion. Corrosion rates of materials exposed to vapors in the headspace are never greater than the corrosion during immersion service. The corrosion at the liquid air interface (LAI) interface is an oxygen concentration cell resulting from the alternate wetting and drying. Vessels that do not maintain a constant liquid level do not tend to form a surface crust and are not expected to be susceptible to LAI corrosion. Corrosion at the LAI could be similar to immersion service and not usually greater. WTP vessels also have the protective passive film at the LAI which reduces corrosion and the liquid level is constantly changing. As compared to the corrosion in the immersion section, the corrosion rates in the vapor space are much lower. Vapor phase corrosion is not a concern.

10 Erosion Analysis

Erosion is the progressive loss of material from a solid surface resulting from mechanical interaction between that surface and a fluid, a multi-component fluid, or solid particles carried with the fluid. Velocities within the vessel are expected to be below 12 ft/s. Erosion allowance of 0.016 inch for Type 304L and 316L stainless steel components with solids content less than 25 wt%.at low velocities is based on 24590-WTP-DB-ENG-01-001. The recommended general erosion wear allowance provides sufficient protection for erosion of the vessel walls. The margin in the erosive wear allowances used above is contained in the calculation 24590-WTP-M0C-50-00004, *Wear Allowance for WTP Waste Slurry Systems.*

Conditions do not suggest that localized erosion will occur; therefore, no localized erosion allowance is necessary for the vessel.

The agitator impeller is expected to experience higher wear; therefore, a more wear-resistant alloy is recommended.

11 Galling of Moving Surfaces Analysis

Where two metals are moving in contact with each other without lubrication, there is a risk of damage to their surfaces. No moving unlubricated surfaces are present within the vessel; therefore, galling is not a concern.

12 Fretting/Wear Analysis

Fretting corrosion refers to corrosion damage caused by a slight oscillatory slip between two surfaces. Similar to galling but at a much smaller movement, the corrosion products and metal debris break off and act as an abrasive between the surfaces, producing a classic three-body wear problem. This damage is induced under load and repeated relative surface motion. Conditions which lead to fretting are not present in this vessel; therefore, fretting is not a concern.

CORROSION EVALUATION

13 Galvanic Corrosion Analysis

Galvanic corrosion is accelerated corrosion caused by the potential difference between the two dissimilar metals in an electrolyte. The galvanic current is sufficient to drive corrosion when the potential difference is greater than 200 mV. One material becomes the anode and the other the cathode. Corrosion occurs on the anode material at the interface where the potential gradient is the greatest. A potential difference of more than 200 mV is needed for a sufficient driving force to initiate galvanic corrosion. The potential difference for any combination of austenitic stainless steels, 6% Mo and, the nickel alloys is not sufficient for galvanic currents to overcome the passive protective film. For such alloys, there is negligible potential difference, so galvanic corrosion is not a concern.

14 Cavitation Analysis

Cavitation is the formation and rapid collapse of cavities or bubbles of vapor or gas within a liquid resulting from mechanical or hydrodynamic forces. Cavitation is typically associated with pumps and orifice plates, not vessels. The agitator blade is susceptible to cavitation. For this reason, agitators are replaceable components. To avoid excessive maintenance, ULTIMET® alloy has been selected for the agitator blades. ULTIMET® alloy, UNS R31233, is a cobalt-chromium alloy which offers resistance to general corrosion, galling, cavitation erosion, slurry erosion, and liquid droplet impact erosion; resistance similar to that of the STELLITE® alloys. This alloy also possesses high tensile strength comparable to many duplex stainless steels combined with excellent impact toughness and ductility.

ULTIMET® alloy is available in most common wrought product forms: plate, sheet, billet, bar, and wire. The alloy has been codified by ASME in Section VIII, Division 1, Boiler and Pressure Vessel Code (BPVC). Specifications for plate, sheet, strip, and bar are covered found in ASTM B-815 and ASTM B-818. Wrought forms of this alloy are furnished in the solution heat-treated condition. Castings using ULTIMET® alloy are produced by re-melting bar stock. Cavitation is not a concern.

15 Creep Analysis

Creep is time-dependent strain occurring under stress and is described as plastic flow, yielding at stresses less than the yield strength. Creep is only experienced in plants operating at high temperatures. Temperatures much greater than one half the absolute melting temperature of the alloy are necessary for thermally activated creep to become a concern. The vessel operating and design temperatures are too low to lead to creep; therefore, creep is not a concern.

16 Inadvertent Nitric Acid Addition

At this time, the design does not provide for the regular use of nitric acid reagent in this system. Addition of nitric acid into the system would require operator intervention to complete the routing. Nitric acid is a known inhibitor solution for austenitic stainless steels, duplex CD4MCu, and high nickel alloys. The presence of nitric acid is not a concern for the stainless steel and nickel alloys; especially at the operating temperatures listed.

17 Conclusion and Justification

The conclusion of this evaluation is that LCP-VSL-00001 & LCP-VSL-00002 can be fabricated from a 300 series stainless steel and is capable of providing 40 years of service. Based on the expected operating conditions, a 300 series stainless steel is expected to be satisfactorily resistant to uniform and localized corrosion. The expected uniform corrosion over 40 years is 0.024 inch. The probable uniform erosion over 40 years is less than 0.016 inch. A total general corrosion and erosion allowance of 0.040 inch is recommended and is sufficient.

The localized corrosion margin is based on comparison of the process conditions documented in 24590-WTP-RPT-PR-04-0001-04 against the limits for Type 316L documented in 24590-WTP-DB-ENG-01-001. The PCDS, which takes into account conditions at contract maximum values, is within the applicable limits.

Conditions do not suggest that localized erosion will occur; therefore, no localized erosion allowance is necessary for the vessel. The agitator impeller is expected to experience higher wear; however, it is expected to be replaced over the life of the facility. One of the most resistant alloys has been selected to extend the useful life.

18 Margin

The vessels are designed with a uniform corrosion allowance of 0.040 inch based on the range of inputs, system knowledge, handbooks, literature, and engineering judgment/experience. The service conditions used for materials selection has been described and results in a total predicted uniform loss of 0.024 inches. The specified corrosion allowance equals the predicted corrosion loss specified in the input calculations. The uniform corrosion design margin for the operating conditions is sufficient to expect a 40 year operating life and is justified in the referenced calculation (24590-WTP-M0C-50-00004). No localized erosion of this component is expected. Since localized erosion effects are not present, additional localized corrosion protection is not required.

The erosion allowance of 0.016 inch is based on 24590-WTP-M0C-50-00004, *Wear Allowance for WTP Waste Slurry Systems*. The recommended uniform erosion allowance provides sufficient protection for erosion of the vessel walls. The margin in the erosive wear allowance is contained in the referenced calculation (24590-WTP-M0C-50-00004).

CORROSION EVALUATION

The maximum operating parameters for this vessel are defined in the PCDS. As shown in the table below, the PCDS calculated pH, chemistry, and temperature are bounded by the materials localized corrosion design limits documented in the WTP Materials Localized Corrosion Design Limits in Table 18-1 of the *Basis of Design*. The difference between the design limits and the operating maximums (PCDS value) is the localized corrosion design margin and, based on the operating conditions, is sufficient to expect a 40 year operating life. The LAW Concentrate Receipt Vessels, LCP-VSL-00001 & LCP-VSL-00002 are protected from localized corrosion (pitting, crevice, and stress corrosion) by operating within the acceptable range of the design limits. Operational and process restriction will be used to ensure the limits are maintained.

Note that the transfer stream from DEP-VSL-00003A/B/C exceeds the limits for the LCP-VSL-00001/2 materials of construction (Type 316L). Operational controls are used to mitigate risk of corrosion to the transfer piping and receiving vessels (24590-BOF-DGCE-MS-16-00022). LCP-VSL-00001/2 are not to be filled solely with the contents of DEP-VSL-00003A/B/C; a heel is present prior to transfers (24590-WTP-PL-PE-16-0001).

MATERIALS LOCALIZED CORROSION DESIGN LIMITS – Type 316L					
	Temperature (°F)	**pH**	**Chloride (molar)**	**Hydroxide (molar)**	**Cl^-/OH^- (molar)**
DESIGN LIMIT	**150 max**	**≥ 10**	**NA**	**NA**	**≤ 2**
Treated LAW Concentrate to LFP-VSL-00001/3 (LCP01)	140	14.63	7.7E-01	4.3E+00	0.181
Inlet Vessels to LCP-VSL-00001/2	**Temperature (°F)**	**pH**	**Chloride (molar)**	**Hydroxide (molar)**	**Cl^-/OH^- (molar)**
DESIGN LIMIT	**150 to 200**	**≥ 10**	**NA**	**NA**	**≤ 1**
Treated LAW Concentrate from TCP-VSL-00001 (TCP03)	176	14.27	7.7E-01	1.9E+00	0.415
Direct Feed from LAWPS (LCP07)	NR				
Effluent Concentrate from DEP-VSL-00003A/B/C (DEP13)	139	12.43	6.3E-01	2.7E-02	23.5

NA = Not applicable; no design limit for these values

NR = Not reported

Inlet vessels to LCP-VSL-00001 & LCP-VSL-00002 based on 24590-WTP-RPT-PR-04-0001-04, Section 6.1, and Figure 5. Stream LCP07, Direct Feed from LAWPS, is considered bounded by stream TCP03 and is not reported.

References sources for this table:

1. Design limits - 24590-WTP-DB-ENG-01-001, Table 18-1, *Basis of Design*
2. LFP-VSL-00001/3 (LCP01) – 24590-WTP-RPT-PR-04-0001-04, *WTP Process Corrosion Data - Vol 4, Figure C-1*
3. TCP-VSL-00001 (TCP03) – 24590-WTP-RPT-PR-04-0001-02, *WTP Process Corrosion Data - Vol 2, Figure A-21*
4. LAWPS (LCP07) – 24590-WTP-RPT-PR-04-0001-04, *WTP Process Corrosion Data - Vol 4, Section 6.1.3.1.1*
5. DEP-VSL-00003A/B/C (DEP13) -- 24590-BOF-RPT-PR-15-001, *Direct Feed LAW Process Corrosion Data, Figure A-6*

CORROSION EVALUATION

19 References

1. 24590-BOF-DGCE-MS-16-00022, *Type 316L In Lieu Of Al6XN Effluent Management Facility (EMF) Concentrate Transfers (Supercedes 24590-BOF-DGCE-MS-16-00021).*
2. 24590-LAW-3ZD-LFP-00001, *LAW Melter Feed Process (LFP) and Concentrate Receipt Process (LCP) System Design Description.*
3. 24590-LAW-MVC-LCP-00002, *LAW Concentrate Receipt Process System (LCP) Data.*
4. 24590-LAW-P1-P01T-00002, *LAW Vitrification Building General Arrangement Plan at El. 3 Feet-0 Inches*.
5. 24590-WTP-M0C-50-00004, *Wear Allowance for WTP Waste Slurry Systems.*
6. 24590-WTP-MVC-50-00009, *LAW, BOF, and Lab Vessel Cyclic Datasheet Inputs.*
7. 24590-WTP-PL-PE-16-0001, *WTP Direct Feed LAW Integrated Processing Strategy Description*.
8. Deleted
9. Deleted
10. 24590-WTP-RPT-PR-04-0001-04, *WTP Process Corrosion Data-Volume 4.*
11. 24590-WTP-DB-ENG-01-001, *Basis of Design*.
12. ASME. *ASME Boiler and Pressure Vessel Code*, Section VIII, Division 1. American Society of Mechanical Engineers, New York, NY.
13. Dillon, CP (Nickel Development Institute), Personal Communication to J R Divine (ChemMet, Ltd., PC), 3 Feb 2000.
14. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTI Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc, St Louis, MO 63141

Additional Reading

- 24590-LAW-M6-LCP-00001001/1002, *P&ID - LAW Concentrate Receipt Process System Concentrate Receipt Vessel LCP-VSL-00001*.
- 24590-LAW-M6-LCP-00002003/2004, *P&ID - LAW Concentrate Receipt Process System Concentrate Receipt Vessel LCP-VSL-00002*.
- 24590-LAW-MFD-LCP-00004, *Mechanical Data Sheet - 24590-LAW-MF-LCP-AGT-00001 - Agitator/Mixer*.
- 24590-LAW-MFD-LCP-00005, *Mechanical Data Sheet - 24590-LAW-MF-LCP-AGT-00002 - Agitator/Mixer*.
- 24590-LAW-MVD-LCP-00004, Rev. 002, *Mechanical Data Sheet - 24590-LAW-MV-LCP-VSL-00001 - LAW Concentrate Receipt Vessel*
- 24590-LAW-MVD-LCP-00005, Rev. 002, *Mechanical Data Sheet - 24590-LAW-MV-LCP-VSL-00002 - Concentrate Receipt Vessel*
- Agarwal, DC, *Nickel and Nickel Alloys*, In: Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
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- Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
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- Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
- Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
- Van Delinder, LS (Ed), 1984, Corrosion Basics, NACE International, Houston, TX 77084
- Zapp, PE, 1998, *Preliminary Assessment of Evaporator Materials of Construction*, BNF—003-98-0029, Rev 0, Westinghouse Savannah River Co., Inc for BNFL Inc.

CORROSION EVALUATION

PROCESS CORROSION DATA SHEET (extract)

Component(s) (Name/ID #) Treated LAW Concentrate Receipt Vessels (LCP-VSL-00001/2)

Facility LAW

In Black Cell? NO

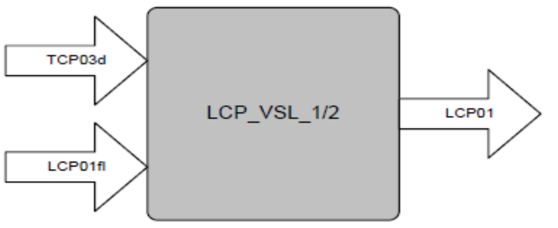
Chemicals	Unit	Stream ID LCP01 AQUEOUS
Cations (ppm)		
Al^{+3} (Aluminum)	ppm	19,272
Fe^{+3} (Iron)	ppm	8111
Hg^{+2} (Mercury)	ppm	15
Pb^{+2} (Lead)	ppm	784
Anions (ppm)		
Cl^{-} (Chloride)	ppm	27,344
CO_3^{-2} (Carbonate)	ppm	153,884
F^{-} (Fluoride)	ppm	38,204
NO_2^{-} (Nitrate)	ppm	34,365
NO_3^{-} (Nitrite)	ppm	153,970
PO_4^{-3} (Phosphate)	ppm	87,428
SO_4^{-2} (Sulfate)	ppm	37,516
$OH(aq)^{-}$	ppm	50,620
$OH(s)^{-}$	ppm	27,996
pH		14.63
Suspended Solids	wt%	0
Temperature	°F	140
Liquid Density*	lb/ft3	72.8-83.6

* Liquid density provided for reference
24590-WTP-DB-PET-17-001

Figure C- 1 LCP-VSL-00001/2 Aqueous PCDS

Vessel : LCP-VSL_1/2

	Stream ID		
	TCP03d	LCP01fl	LCP01
Properties			
Suspended Solids [wt %]	0	0	0
Total Salts [wt %]	39.36	0.01	90.32
Sodium Molarity [M]	7.83E+00	5.49E-05	10.00
Relative Humidity [%]	n/a	n/a	n/a
pH	14.16	10.49	14.63
Anti-Foam Agent [ppm]	1.29E+02	7.98E-02	2.03E+02
TOC [kg/h]	1.46E+00	1.03E-03	3.47E+02
Pressure [bar]	0.99	0.99	0.98
Temperature [C]	65.56	35.00	60.00
Temperature [F]	150.00	95.00	140.00
Water Flow Rate [kg/hr]	332.00	87.51	419.50
Total Aqueous Flow Rate [kg/hr]	547.51	87.52	4333.49
Total Flow Rate [kg/hr]	5.48E+02	8.75E+01	4.33E+03
UserNote	VIT LIQUID Line Flush	VIT LIQUID LAW VIT Liquid to Flush VIT01	VIT LIQUID LAW Concentrate
AQUEOUS			
Cations (ppm)			
Ag+	1	0	1
Al+3	8558	2	19272
Am+3	0	0	0
As+5	3	0	4
B+3	479	0	1010
Ba+2	1	0	1
Be+2	0	0	0
Bi+3	10	0	20
Ca+2	321	0	803
Cd+2	2	0	3
Ce+4	482	0	953
Co+2	1	0	1
Cr+3	0	0	0
Cr+6	426	0	1293
Cs+	0	0	0
Cu+2	1	0	1
Eu+3	0	0	0
Fe+2	0	0	0
Fe+3	518	0	8111
H+	0	0	0
Hg+2	1	0	15
K+	2584	0	3171
La+3	1	0	1
Li+	154	0	534
Mg+2	65	0	242
Mn+4	6	0	906
Mo+6	9	0	10
Na+	135269	1	165462
Nd+3	3	0	4
Ni+2	33	0	54
Pb+2	18	0	784
Pd+2	0	0	1
Pr+4	0	0	0
Pu+4	0	0	0
Ra+2	0	0	0
Rb+	0	0	0
Rh+3	0	0	1
Ru+4	1	0	1
Sb+3	3	0	3
Se+4	10	0	13
Si+4	1785	1	3644
Sr+2	43	0	58
Ta+5	0	0	0
Tc+4	0	0	0
Te+4	0	0	0
Th+4	0	0	1
Ti+4	80	0	156
Tl+5	9	0	11
U+4	0	0	0
V+3	2	0	2
W+6	2	0	3
Y+3	0	0	0
Zn+2	290	0	580
Zr+4	181	0	329
Anions (ppm)			
B(OH)4-	0	0	0
C2O4-2	1727	20	4283
Cl-	22968	12	27344
CN-	1	0	1
CO3-2	16645	5	153884
F-	32092	0	38204
H2PO4-	0	0	0
H2SiO4-2	0	0	0
H3SiO4-	0	0	0
HCO3-	0	0	0
HPO4-2	0	0	0
HSO3-	0	0	0
HSO4-	0	0	0
I-	0	0	0
IO3-	0	0	0
NH4+	0	0	0
NO2-	25857	3	34365
NO3-	95953	49	153970
O-2	0	0	0
O2-2	0	0	0
OH(aq)-	18386	5	50620
OH(s)-	11305	4	27996
PO4-3	5564	1	87428
SO3-2	0	0	0
SO4-2	5800	1	37516
Organics (ppm)			
AFA_DCMP	2507	1	4415
AFA_NVOC	129	0	203
NVOC	3005	0	72425
Sucrose	215	0	371
SVOC	74	5	1835
VOC	27	7	875



GENERAL NOTE FOR USE OF PCDS:

- *The information provided by the PCDS report is intended solely for use in support of the vessel material selection process and Corrosion Evaluations. The inputs, assumptions, and computational/engineering models used in generating the results presented herein are specific to this effort. Use of the information presented herein for any other purpose will require separate consideration and analysis to support justification of its use for the desired, alternative purpose.*
- *The process descriptions in this report cover routine process operations and non-routine (infrequent) process operations, when such exist, that could impact corrosion or erosion of process equipment.*
- *The data in the non-shaded columns of the PCDSs has NOT been adjusted to comply with the highest expected, vessel-specific operational conditions.*
- *The process descriptions provided in this report are for general information and reflective of the corrosion engineer's analysis for transparency, the information is current only at the time this document is issued. These process descriptions should not be referenced for design.*

6.1 Treated LAW Concentrate Receipt Vessels (LCP-VSL-00001/2)

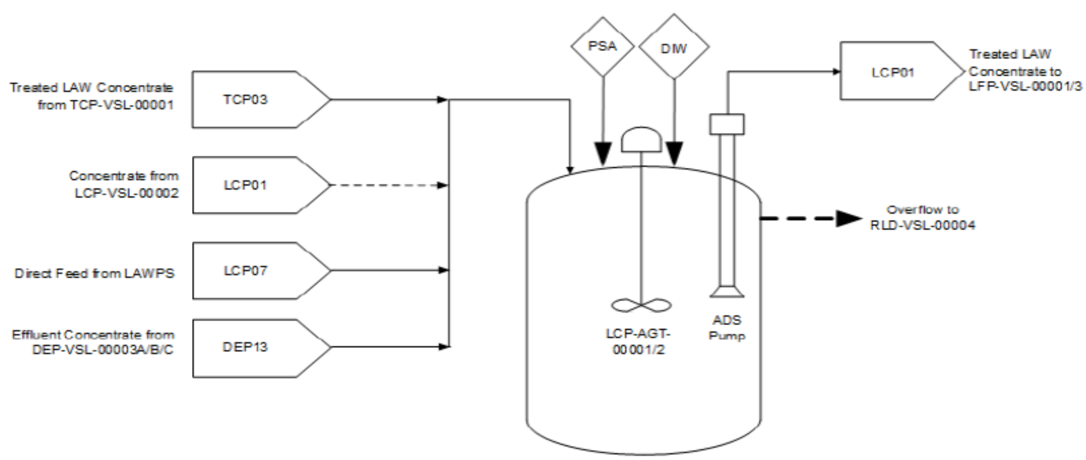
6.1.1 Description of Vessel/Equipment

The LAW Concentrate Receipt Process (LCP) system receives LAW concentrate from the Treated LAW Concentrate Storage Process (TCP) system or Direct LAW Feed from LAWPS and acts as a buffer/ storage vessel for LAW feed sent to the LFP System. The treated LAW feed is transferred from LCP-VSL-00001/2 to the melter feed preparation vessels (LFP-VSL-00001/3) where it is mixed with glass formers in preparation of sending it to the LAW melters.

LCP-VSL-00001 and LCP-VSL-00002 will have the same stream properties and henceforth they are collectively referred to as LCP-VSL-00001/2. Treated LAW concentrate is received in these vessels at a minimum flowrate of 88 gal/min from TCP-VSL-00001 (24590-WTP-DB-ENG-01-001, Table 6-2, Ref. 7.1.1(2)).

Figure 5 is a sketch of the input and output arrangement of streams for LCP-VSL-00001/2. Streams that are not primary routes (infrequent transfers) are represented with dashed lines.

Figure 5 LCP-VSL-00001/2 Sketch



6.1.2 System Functions

The process functions of these vessels are as follows:

- Receive Treated LAW Concentrate (PT or DFLAW)
- Act as Storage for Treated LAW Concentrate from PT Facility to LAW Facility
- Mix Treated LAW Concentrate
- Transfer Treated LAW Concentrate to MFPV

These vessels perform additional system functions beyond the process functions, but these are outside the scope of this document. The non-process functions are not discussed any further in this document. However, they are listed below for completeness:

- Confine Hazardous Materials
- Flush System Components
- Report System Data
- Sample Treated LAW Concentrate

6.1.3 Description of Process Functions

6.1.3.1 Receive Treated LAW Concentrate

The following process streams taken from process flow diagram 24590-LAW-M5-V17T-00001/2 (Ref. 7.1.3(13)(14)) are inputs to LCP-VSL-00001/2:

- TCP03 - Treated LAW concentrate from TCP-VSL-00001
- LCP07 - Direct LAW Feed from LAWPS (DFLAW)
- DEP13 - Recycles from DEP-VSL-00003A/B/C (DFLAW)
- Treated LAW Concentrate from LCP-VSL-00001/2

6.1.3.1.1 TCP03 - Treated LAW concentrate from TCP-VSL-00001

Stream TCP03 is the concentrated treated LAW product sent to LCP-VSL-00001/2 from TCP-VSL-00001. The target sodium concentration for stream TLP02 (treated LAW concentrate from TLP evaporator) is 5-10M Na (8 to 10 molar sodium for Envelope A and C, and 5 molar for Envelope B) depending on the LAW envelope being processed (24590-WTP-DB-PET-09-001, Section 6.2.2, Ref. 7.1.1(3)). A maximum specific gravity of 1.4 has been specified based on potential rheological concerns in LAW Vitrification after the addition of glass forming chemicals. The TLP evaporator is set to a specified concentration, which can be changed as the process requires. Stream TLP02 feeds TCP-VSL-00001, which only adds flush water, prior to transfer to LCP-VSL-00001/2. LCP07 and DEP13 are bounded by TCP03, therefore are not reported.

Molarity

TCP-VSL-00001 adds vessel wash water to dilute the TLP concentrate. For most feeds, the sodium concentration of TCP03 will range from 7.5 to 8.4 M (24590-WTP-DB-PET-09-001, Table A-25, Ref. 7.1.1(3)). The sodium concentration of TLP02 and LCP01 may range from 5 to 10 M (24590-WTP-DB-PET-09-001, Section 4.10.2, Ref. 7.1.1(3)). Assuming no dilution due to flush water addition, 8 M is the nominal sodium molarity for stream TCP03. The upper highest expected sodium molarity is 10 M.

Temperature
The normal operating temperature range of stream TCP03 is 122 to 126°F (24590-PTF-MVC-TCP-00004, Sheet 7, Ref. 7.1.4(26)). However, stream TLP02 is transferred from TLP-SEP-00001 at a max operation temperature of 150°F. Therefore, 123°F is considered nominal temperature and 150°F is considered upper temperature for stream TCP03.

Solids Concentration
The solids concentration for stream TCP03 will normally range from 0-0.2 wt% UDS (24590-WTP-DB-PET-09-001, Table A-25, Ref. 7.1.1(3)). The nominal solids concentration is the average of this range, 0.1 wt%, which is due to cooling of the treated LAW concentrate after it goes through the IX columns. The upper limit for solids in TCP03 is 3.4 wt% (24590-WTP-RPT-ENG-08-021-04, Table A-3, Ref. 7.1.1(8)). Therefore, 3.4 wt% is considered the upper highest expected solids concentration for stream TCP03.

Slurry Density
The slurry density of stream TCP03 will range from 80.7 lb/ft^3 to 85.7 lb/ft^3 (24590-WTP-DB-PET-09-001, Table A-25, Ref. 7.1.1(3)). The normal slurry density is the average of this range, 83.2 lb/ft^3.

Slurry pH
Liquid pH is not a controlled parameter for stream TCP03. The pH range given in the PIBOD is 14 to 15 (24590-WTP-DB-PET-09-001, Table A-25, Ref. 7.1.1(3)). The resulting pH for this stream will be provided in the corrosion data sheet.

6.1.3.1.2 Treated LAW Concentrate from LCP-VSL-00001/2 (off-normal)

LCP-VSL-00001 and LCP-VSL-00002 are interchangeable and can transfer treated LAW concentrate to and from each other. This is done to allow flexibility in the Plant so each of the melter trains can be utilized.

This transfer is considered an off-normal event and will not be discussed further.

6.1.3.2 Mix Treated LAW Concentrate

The treated LAW concentrate is mixed using mechanical agitation. Each vessel contains one agitator. LCP-VSL-00001/2 agitator requirements are provided in 24590-LAW-MFD-LCP-00004/5 (Ref. 7.1.5(2)/(3)).

6.1.3.3 Transfer Treated LAW Concentrate to MFPV

The following process streams taken from process flow diagram 24590-LAW-M5-V17T-00001/2 (Ref. 7.1.3(13)(14)) and associated DCNs 24590-LAW-M5N-V17T-00011 (Ref. 7.1.3(20)) and 24590-LAW-M5N-V17T-00020 (Ref. 7.1.3(22)) are outputs from LCP-VSL-00001/2:

- LCP01 - Treated LAW Concentrate to LFP-VSL-00001/3
- Overflow to RLD-VSL-00004 (off-normal)

6.1.3.3.1 LCP01 - Treated LAW Concentrate to LFP-VSL-00001/3

Stream LCP01 is the blended feed from the concentrate receipt vessel (LCP-VSL-00001/2) to the melter feed preparation vessel, LFP-VSL-00001/3. Stream LCP01 is treated LAW concentrate with some flush water.

Molarity
LCP-VSL-00001 adds vessel wash water to dilute the TLP concentrate. For most feeds, the sodium concentration of LCP01 will range from 5.9 to 6.7 M (24590-WTP-DB-PET-09-001, Ref. 7.1.1(3), Table B-16). The sodium concentration of TLP02 and LCP01 may range from 5 to 10 M (24590-WTP-DB-PET-09-001, Ref. 7.1.1(3), Section 5.2.1 & 4.10.2). Assuming no dilution due to flush water addition, 8 M is the nominal sodium molarity for stream LCP01. The upper highest expected sodium molarity is 10 M.

Temperature
The nominal temperature of waste coming from LCP-VSL-00001 is 123°F (24590-LAW-MVC-LCP-00002, Ref. 7.1.4(20), Section 8) and the maximum operating temperature where stream LCP01 originates is 140°F (24590-LAW-MVC-LCP-00002, Ref. 7.1.4(20)). Therefore, 123°F is considered nominal temperature and 140°F is considered upper temperature for stream LCP01 (24590-LAW-MVC-LCP-00002, Ref. 7.1.4(20)).

Solids Concentration
The solids concentration for stream LCP01 will normally range from 1.8-2.4 wt% UDS (24590-WTP-DB-PET-09-001, Ref. 7.1.1(3), Table B-16). The nominal solids concentration is the average of this range, 2.1 wt%. Stream LCP01 will have the same solids concentration as stream TCP03, assuming no dilution (due to flush water addition) in LCP-VSL-00001. The upper limit for solids in TCP03 is 3.4 wt% (24590-WTP-RPT-ENG-08-021-04, Ref. 7.1.1(8), Table A-3). However, the maximum operating wt% suspended solids in the concentrate is 3.8 wt% (24590-LAW-MVC-LCP-00002, Ref. 7.1.4(20), Section 8). Therefore, 3.8 wt% is considered upper highest expected solids concentration for stream LCP01.

Slurry Density
The slurry density of stream LCP01 will range from 77.2 lb/ft^3 to 81.2 lb/ft^3 (24590-WTP-DB-PET-09-001, Ref. 7.1.1(3), Table B-16). The normal slurry density is the average of this range, 79.2 lb/ft^3. The maximum density of stream LCP01 is 91.1 lb/ft^3 (1.46g/ml) (24590-LAW-MVC-LCP-00002, Ref. 7.1.4(20), Section 6.1.4).

Slurry pH
Liquid pH is not a controlled parameter for stream LCP01. The pH range given in the PIBOD is 14 to 15 (24590-WTP-DB-PET-09-001, Ref. 7.1.1(3), Table B-16). The resulting pH for this stream will be provided in the corrosion data sheet.

6.1.3.3.2 Overflow to RLD-VSL-00004 (off-normal)

Overflow to RLD-VSL-00004 would have the same properties as LCP01 but is considered an off-normal event. Therefore, this transfer will not be discussed further in this document.

6.1.4 Process Modes

6.1.4.1 Normal Operations

Based on the assessment of streams frequently transferred in and out of LCP-VSL-00001/2, two normal processing modes are considered:

1) Receipt of Treated LAW Concentrate Feed from TCP-VSL-00001
2) Transfer of Treated LAW Concentrate to LFP-VSL-00001/3

Section 6.1.5.1 summarizes in tabular form each of these processing modes.

6.1.4.2 Infrequent Operations

LCP-VSL-00001/2 has the capability of receiving treated LAW concentrate from one another.

6.1.5 Summary of Processing Conditions for LCP-VSL-00001/2

6.1.5.1 Normal Operations

The following table summarizes the normal processing modes for vessel LCP-VSL-00001/2.

Summary of LCP-VSL-00001/2 Normal Waste Conditions for Processing

Stream Number	Weight % UDS		Na Molarity		Temperature (°F)	
	normal	upper	normal	upper	normal	upper
TCP03	0.1	3.4	8	10	123	150
LCP01	2.1	3.8	8	10	123	140

CORROSION EVALUATION

LFP-VSL-00001 & LFP-VSL-00003
Melter 1 & 2 Feed Preparation Vessels

Appurtenances
LFP-AGT-00001, LFP-AGT-00003

Contents of this document are Dangerous Waste Permit affecting

Results

Materials Considered

Material (UNS No.)	Acceptable Material
Type 304L (S30403)	
Type 316L (S31603)	X
AL-6XN® 6% Mo (N08367)	X
Hastelloy® C-22® (N06022)	X
Stellite® 12 (R30012)	X (agitator impellor only)

Recommended Material Types:
Vessel head/shell – Type 316 (max 0.030%C; dual certified)
Vessel support – Type 304 or 316 (max 0.030% C; dual certified)
Internal piping – Type 316 (max 0.030% C; dual certified)
Agitator impeller: Stellite® 12 or equivalent

Minimum Corrosion Allowance:
0.04 inch required on top head (includes 0.024 inch corrosion allowance and 0.016 inch general erosion allowance)
0.125 inch required on bottom head and shell (includes erosion and corrosion)

Inputs and References

- Operating temperature (°F) (nom/max): 98/123 (24590-LAW-MVC-LFP-00001)
- Uniform corrosion allowance, top head (inch): 0.024 (24590-WTP-DB-ENG-01-001)
- Uniform erosion allowance, top head (inch): 0.016 (24590-WTP-DB-ENG-01-001)
- Vessel bottom design corrosion allowance (inch): 0.125 (24590-WTP-M0C-50-00004)
- Location: Rooms L-0123 & L-0124 (24590-LAW-P1-P01T-00002)
- Operating conditions are as stated in the applicable section of *WTP Process Corrosion Data – Volume 3* (24590-WTP-RPT-PR-04-0001-03)

Assumptions and Justification (refer to Section 19—References)

- Source data presented on the PCDS are conservative with respect to corrosion as stated therein.[10]
- The feed prep vessels have cooling jackets to control contents temperature.[10]
- Vessels are equipped with a mechanical agitator to continuously mix the vessel contents to keep insoluble solids in suspension.[1]
- The pH range of 7 to 7 reported for stream LFP01 in Section 6.1.3.2.1 of the PCDS attached should be reported as "not applicable" as the stream is a non-liquid stream and reporting a pH is not appropriate.

Operating Restrictions

- To protect against localized corrosion in the vessel and transfer piping, develop procedure to bring the vessel contents to within the limits defined for Type 316L in 24590-WTP-DB-ENG-01-001, *Basis of Design,* in the event that temperature, pH, or chloride concentration exceeds those limits.
- Develop a procedure to control, at a minimum, cleaning, rinsing, and flushing of vessel and internals, as applicable.
- Develop procedure to control lay-up and storage; includes both before plant is operational and during inactive periods after start-up.
- Procedures are to be reviewed and accepted by MET prior to use.

Concurrence **TD**
Operations

5	3/29/19	Revised to include pages that were not included with issued document. No technical changes have been made from Rev 4 to Rev 5	Originator By: Dr. Robert Davis - rbdavis Org Name: Bechtel Placed: Feb 01, 2019 RBDavis	Checked By: - mfang Org Name: Placed: Feb 06, 2019 MFang	REVIEWED By Rangus at 1:45 pm, 3/21/19 APRangus	JLJulyk
REV	**DATE**	**REASON FOR REVISION**	**ORIGINATE**	**CHECK**	**REVIEW**	**APPROVE**

CORROSION EVALUATION

REVISION HISTORY

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	MET	APPROVER
4	11/14/18	Update references Explanation of pH for LFP01	DLAdler	MFang	RBDavis	JLJulyk
3	3/23/16	Complete re-write; no rev bars shown New format Incorporate updated PCDS Update references	DLAdler	TRangus	RBDavis	TErwin
2	10/14/04	Remove LFP-VSL-00002/4 to another CE Incorporate new PCDS Update Section j -- Erosion Add Section p – Inadvertent Addition of Nitric Acid Revise agitator materials recommendation	DLAdler	JRDivine	NA	APRangus
1	7/23/03	Update design temp/pressure/assoc. items Update vessel number and descriptions Eliminate Stellite overlay recommendation Revise CA recommendation Remove reference to open issues Re-format references Append updated MSDS Add DWP note	DLAdler	HMKrafft	NA	APRangus
0	7/8/02	Initial Issue	DLAdler	JRDivine	SS	SMKirk

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 16 sheets.

CORROSION EVALUATION

Corrosion/Erosion Detailed Discussion

The Low-Activity Waste (LAW) Melter Feed Process (LFP) system receives LAW concentrate from the LAW Concentrate Receipt Process (LCP) system and mixes the waste with glass formers and sucrose from the Glass Formers Reagent (GFR) system. The mixed melter feed is transferred from the melter feed preparation vessels (MFPV) to the melter feed vessels (MFV) where it is pumped to the LAW melters.

LFP-VSL-00001 and LFP-VSL-00003 are the same vessels in every way except that LFP-VSL-00001 is the MFPV for LAW melter 1 and LFP-VSL-00003 is the MFPV for LAW melter 2. Therefore, the stream properties of these vessels will be the same and henceforth they are collectively referred to as LFP-VSL-00001/3. LAW concentrate is received in these vessels from LCP-VSL-00001/2. Glass formers are received in LFP-VSL-00001/3 from a glass former mixer enclosure (GFR-TK-00022/23).

Where the pages of the attached PCDS report refer to transfers between LAW and Pretreatment (PT) facilities, those transfers are available only during baseline configuration and are isolated during Direct Feed Low-Activity Waste (DFLAW) configuration. Under the DFLAW configuration, effluent concentrate is transferred from DEP-VSL-00003A/B/C to LCP-VSL-00001/2. In the unlikely event that an off-spec batch is generated, the off-spec batch can be returned to the Tank Farms via the LAW radioactive liquid waste disposal (RLD) system, the Direct Feed LAW Effluent Management Facility Process System (DEP), and the underground transfer lines.

1 General/Uniform Corrosion Analysis

a Background

General or uniform corrosion is corrosion that is distributed uniformly over the surface of a material without appreciable localization. This leads to relatively uniform thinning on sheet and plate materials and general thinning on one side or the other (or both) for pipe and tubing. It is recognized by a roughening of the surface and usually by the presence of corrosion products. The mechanism of the attack is an electrochemical process that takes place at the surface of the material. Differences in composition or orientation between small areas on the metal surface create anodes and cathodes that facilitate the corrosion process.

b Component-Specific Discussion

This vessel receives treated LAW concentrate for mixture with glass formers. The normal pH, chloride concentration, and temperatures are such that Type 316L stainless steel will be acceptable. The solution is normally constantly mixed using mechanical agitators, and sampling is performed. The uniform corrosion rate is low under these conditions. Based on 24590-WTP-M0C-50-00004, *Wear Allowance for WTP Waste Slurry Systems*, 0.040 inch corrosion allowance is sufficient for the top head of the vessel, not impacted by the erosion caused by the mechanical agitators in slurry with glass former service. For conservatism, in vessels containing mechanical agitators, a design corrosion allowance of 0.125 inch should be used for the vessel bottoms to provide a 40-year service life in waste slurries with glass formers.

Evaluation of the cooling jackets is documented in 24590-LAW-N1D-LFP-00001.

2 Pitting Corrosion Analysis

Pitting is localized corrosion of a metal surface that is confined to a point or small area and takes the form of cavities. Dillon (2000) states that in alkaline solutions, pH>12, chlorides are likely to promote pitting only in tight crevices such as might form after partial removal of deposits during multiple rinse cycles. The nominal operating temperature is 98 °F with a range of 77 to 150 °F. At these temperatures, both Type 304L and Type 316L stainless steel would be acceptable in the proposed alkaline waste.

The chemistry and operating conditions in this vessel fall within the limits established for 300 series stainless steel in Table 18-1 of 24590-WTP-DB-ENG-01-001, *Basis of Design*. For convenience, this comparison is documented on page 6 of this corrosion evaluation.

3 Crevice Corrosion Analysis

Crevice corrosion is a form of localized corrosion of a metal or alloy surface at, or immediately adjacent to, an area that is shielded from full exposure to the environment because of close proximity of the metal or alloy to the surface of another material or an adjacent surface of the same metal or alloy. Crevice corrosion is similar to pitting in mechanism. Crevices in this vessel are limited by the design and fabrication practice.

The chemistry and operating conditions in this vessel fall within the limits established for 300 series stainless steel in Table 18-1 of 24590-WTP-DB-ENG-01-001.

4 Stress Corrosion Cracking Analysis

Stress corrosion cracking (SCC) is the cracking of a material produced by the combined action of corrosion and sustained tensile stress (residual or applied). The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, and the environment; also, chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even concentrations as low as 10 ppm can lead to cracking under some conditions.

The chemistry and operating conditions in this vessel fall within the limits established for 300 series stainless steel in Table 18-1 of 24590-WTP-DB-ENG-01-001.

5 End Grain Corrosion Analysis

End grain corrosion is preferential corrosion which occurs along the worked direction of wrought stainless steels exposed to highly oxidizing acid conditions. End grain corrosion is exclusive to metallic product forms with exposed end grains from shearing or mechanical cutting and only occurs when exposed end grains are exposed to highly oxidizing acid conditions. Such conditions are not present in this vessel; therefore, end grain corrosion is not a concern.

6 Weld Corrosion Analysis

The welds used in the fabrication will follow the WTP specifications and standards for quality workmanship. The materials selected for this fabrication are compatible with the weld filler metals and ASME/ AWS practice. Using the welding practices specified for the project there should not be gross micro-segregation, precipitation of secondary phases, formation of unmixed zones, or volatilization of the alloying elements that could lead to localized corrosion of the weld. Assuming that correct weld procedures are followed, no preferential corrosion of weld beads or heat-affected zones occurs in the expected aqueous chemistry and temperature.

7 Microbiologically Influenced Corrosion Analysis

Microbiologically influenced corrosion (MIC) refers to corrosion affected by the presence or activity, or both, of microorganisms. Typically, with the exception of cooling water systems, MIC is not observed in operating systems. In this system, the proposed operating conditions are not conducive to microbial growth. Rinsing with untreated process water may be a concern. The use of demineralized water for rinsing is recommended. Conditions that lead to MIC are not present in this system.

Evaluation of the cooling jackets is documented in 24590-LAW-N1D-LFP-00001.

8 Fatigue/Corrosion Fatigue Analysis

Fatigue is the process of progressive localized permanent structural change occurring in a material subjected to fluctuating stresses at less than the ultimate tensile strength of the material. Corrosion fatigue is the process wherein a metal fractures prematurely under conditions of simultaneous corrosion and repeated cyclic loading at lower stress levels or fewer cycles than would be required to cause fatigue of that metal in the absence of the corrosive environment. Based on the anticipated low mechanical and thermal cycling (Attachment C of 24590-WTP-MVC-50-00009, *Lab, BOF, and LAW Vessel Cyclic Datasheet Inputs*), it can be stated that conditions which lead to fatigue or corrosion fatigue are not present in this vessel.

9 Vapor Phase Corrosion Analysis

Conditions in the vapor phase and at the vapor/liquid interface can be different than those present in the liquid. The vapor space corrosion is self-limiting due to the passive film. Also, the layers of deposited corrosion product on top of the passive film act as barriers that reduce mass transport necessary for corrosion. Corrosion rates of materials exposed to vapors in the headspace are never greater than the corrosion during immersion service. The corrosion at the liquid air interface (LAI) is an oxygen-concentration cell resulting from the alternate wetting and drying occurring at the interface. Vessels that operate at the same liquid level and form a surface crust are more susceptible to LAI corrosion. Corrosion at the LAI could be similar to immersion service and not usually greater. WTP vessels also have the protective passive film at the LAI which reduces corrosion and the liquid level is constantly changing. As compared to the corrosion in the immersion section, the corrosion rates in the vapor space are much lower. Vapor phase corrosion is not a concern.

10 Erosion Analysis

Erosion is the progressive loss of material from a solid surface resulting from fluid flow. The material loss is caused by mechanical interaction between the surface and the fluid, as the velocity increases the material loss increases. When the fluid contains a second phase, “two phase solution”, erosion rates increase rapidly. The second phase material can be solid particles like sand or air/steam bubbles. WTP is more concerned with the solid particle impingement; the solid particles are generally oxides of waste.

The slurry velocity on the vessels’ sides and bottoms will be proportional to the tip speed of the agitator blades. Based on 24590-WTP-M0C-50-00004, velocities at the walls and bottom of the vessels are expected to be below 10 ft/s. For conservatism, a design corrosion allowance of 0.125 inch, based on a velocity of 10 ft/s, should be used for the vessel bottoms to provide a 40-year service life.

As stated in 24590-WTP-3PS-MACS-T0003, *Engineering Specification for Mechanical Agitators*, the agitator blades shall be cast cobalt-based Stellite® 12, which demonstrates heightened wear resistance (Stellite® 12 Alloy Technical Data Publication, Kennametal, Inc.). Based on the use of wear resistant materials, and the fact that the agitators are maintainable and replaceable, no erosion allowance is specified.

11 Galling of Moving Surfaces Analysis

Where two metals are moving in contact with each other without lubrication, there is a risk of damage to their surfaces. No moving unlubricated surfaces are present within the vessel; therefore, galling is not a concern.

12 Fretting/Wear Analysis

Fretting corrosion refers to corrosion damage caused by a slight oscillatory slip between two surfaces. Similar to galling but at a much smaller movement, the corrosion products and metal debris break off and act as an abrasive between the surfaces, producing a classic three-body wear problem. This damage is induced under load and repeated relative surface motion. Conditions which lead to fretting are not present in this vessel; therefore, fretting is not a concern.

CORROSION EVALUATION

13 Galvanic Corrosion Analysis

Galvanic corrosion is accelerated corrosion caused by the potential difference between the two dissimilar metals in an electrolyte. The galvanic current is sufficient to drive corrosion when the potential difference is greater than 200 mV. One material becomes the anode and the other the cathode. Corrosion occurs on the anode material at the interface where the potential gradient is the greatest. A potential difference of more than 200 mV is needed for a sufficient driving force to initiate galvanic corrosion. The potential difference for any combination of alloys used in the vessel design is not sufficient for galvanic currents to overcome the passive protective film. For such alloys, there is negligible potential difference, so galvanic corrosion is not a concern.

14 Cavitation Analysis

Cavitation is the formation and rapid collapse of cavities or bubbles of vapor or gas within a liquid resulting from mechanical or hydrodynamic forces. Cavitation is typically associated with pumps and orifice plates, not vessels. The agitator blade is susceptible to cavitation. For this reason, agitators are replaceable components. To avoid excessive maintenance, a Stellite® alloy has been selected for the agitator blades. The cobalt-chromium alloy offers resistance to cavitation damage. This alloy also possesses high tensile strength comparable to many duplex stainless steels combined with excellent impact toughness and ductility.

15 Creep Analysis

Creep is time-dependent strain occurring under stress and is described as plastic flow, yielding at stresses less than the yield strength. Creep is only experienced during operations at high temperatures. Temperatures much greater than one half the absolute melting temperature of the alloy are necessary for thermally-activated creep to become a concern. The vessel operating and design temperatures are too low to lead to creep; therefore creep is not a concern.

16 Inadvertent Nitric Acid Addition

At this time, the design does not provide for the regular use of nitric acid reagent in this system. Addition of nitric acid into the system would require operator intervention to complete the routing. Nitric acid is a known inhibitor solution, and at the operating temperatures listed, the presence of nitric acid is not a concern.

17 Conclusion and Justification

The conclusion of this evaluation is that LFP-VSL-00001 and LFP-VSL-00003 can be fabricated from a 300 series stainless steel and are capable of providing 40 years of service. Based on the expected operating conditions, a 300 series stainless steel is expected to be satisfactorily resistant to uniform and localized corrosion. Based on 24590-WTP-DB-ENG-01-001, the probable loss due to uniform corrosion over 40 years is 0.024 inch. A design corrosion allowance of 0.04 inch is recommended for the top head (unaffected by the mechanical agitator) and exceeds the corrosion and erosion allowances identified in 24590-WTP-M0C-50-00004 and 24590-WTP-RPT-M-04-0008, *Evaluation of Stainless Steel and Nickel Alloy Wear Rates in WTP Waste Streams at Low Velocities*.

Based on comparison of the process conditions documented in 24590-WTP-RPT-PR-04-0001-03 against the limits for Type 316L documented in 24590-WTP-DB-ENG-01-001, the PCDS values, which take into account conditions at contract maximum values, are within the applicable limits.

Additional localized protection for the bottom head and shell will accommodate wear due to the mechanical agitators and is based on 24590-WTP-M0C-50-00004.

18 Margin

The uniform corrosion allowance for slurry with glass formers is 0.125 inch (0.04 inch corrosion allowance otherwise) based on the range of inputs, system knowledge, handbooks, literature, and engineering judgment/experience. The service conditions described above result in a predicted uniform loss due to uniform corrosion of 0.024 inches. The specified minimum corrosion allowance (0.04 inch for top head and 0.125 inch for bottom head and shell) equals or exceeds the minimum required corrosion allowance specified in the input calculations; therefore, margin is provided. The uniform corrosion design margin for the operating conditions is sufficient to expect a 40-year operating life and is justified in the referenced calculations.

The localized corrosion margin is based on comparison of the process conditions documented in 24590-WTP-RPT-PR-04-0001-03 against the limits for Type 316L documented in 24590-WTP-DB-ENG-01-001. The PCDS values, which take into account conditions at contract maximum values, are within the applicable limits.

Localized protection for the bottom head and shell (0.125 inch) will accommodate wear due to the mechanical agitator. The localized erosion design margin is documented and justified in the calculations 24590-WTP-M0C-50-00004 and is sufficient to expect a 40-year operating life.

The maximum operating parameters for this vessel are defined in the PCDS. As shown in the table below, the PCDS calculated pH, chemistry, and temperature are bounded by the materials localized corrosion design limits documented in the WTP Materials Localized Corrosion Design Limits in Table 18-1 of the *Basis of Design*. The difference between the design limits and the operating maximums (PCDS value) is the localized corrosion design margin and, based on the operating conditions, is sufficient to expect a 40-year operating life. The Melter 1 & 2 Feed Preparation Vessels, LFP-VSL-00001 & LFP-VSL-00003, are protected from localized corrosion (pitting, crevice corrosion, and stress corrosion cracking) by operating within the range of the design limits. Operational and process restrictions will be used to ensure the limits are maintained.

CORROSION EVALUATION

MATERIALS LOCALIZED CORROSION DESIGN LIMITS – Type 316L					
	Temperature (°F)	**pH**	**Chloride (molar)**	**Hydroxide (molar)**	**Cl^-/OH^- (molar)**
DESIGN LIMIT	**150 max**	**≥ 10**	**NA**	**NA**	**≤ 2**
Melter feed to LFP-VSL-00002/4 (LFP05)	150	14.3	3.4E-01	1.9E+00	0.176
Inlet Vessels to LFP-VSL-00001/3	**Temperature (°F)**	**pH**	**Chloride (molar)**	**Hydroxide (molar)**	**Cl^-/OH^- (molar)**
DESIGN LIMIT	**150 max**	**≥ 10**	**NA**	**NA**	**≤ 2**
Treated LAW concentrate from LCP-VSL-00001/2 (LCP01)	140	14.6	7.7E-01	4.3E+00	0.181

NA = not applicable; no design limit for these values

Inlet vessel to LFP-VSL-00001/3 based on 24590-WTP-RPT-PR-04-0001-03, Section 6.1, and Figure 18.

References sources for this table:

1) Design limits - 24590-WTP-DB-ENG-01-001, Table 18-1
2) LCP-VSL-00001/2 (LCP01) – 24590-WTP-RPT-PR-04-0001-04, Figure C-1

19 References

1. 24590-LAW-3ZD-LFP-00001, *LAW Melter Feed Process (LFP) and Concentrate Receipt Process (LCP) System Design Description*.
2. 24590-LAW-MVC-LFP-00001, *LAW Melter Feed Process System (LFP) Data*.
3. 24590-LAW-N1D-LFP-00001, *LFP-HX-00001/2/3/4 (LAW) - Corrosion Evaluation*.
4. 24590-LAW-P1-P01T-00002, *LAW Vitrification Building General Arrangement Plan at El. 3 Feet-0 Inches*.
5. Deleted
6. 24590-WTP-M0C-50-00004, *Wear Allowance for WTP Waste Slurry Systems.*
7. 24590-WTP-MVC-50-00009, *Lab, BOF, and LAW Vessel Cyclic Datasheet Inputs.*
8. 24590-WTP-RPT-M-04-0008, *Evaluation of Stainless Steel and Nickel Alloy Wear Rates in WTP Waste Streams at Low Velocities*.
9. Deleted
10. 24590-WTP-RPT-PR-04-0001-03, *WTP Process Corrosion Data - Volume 3.*
11. 24590-WTP-DB-ENG-01-001, *Basis of Design*.
12. 24590-WTP-3PS-MACS-T0003, *Engineering Specification for Mechanical Agitators*.
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CORROSION EVALUATION

PROCESS CORROSION DATA SHEET (extract)

Component(s) (Name/ID #) LAW Melter Feed Preparation Vessel (LFP-VSL-00001/3)

Facility LAW

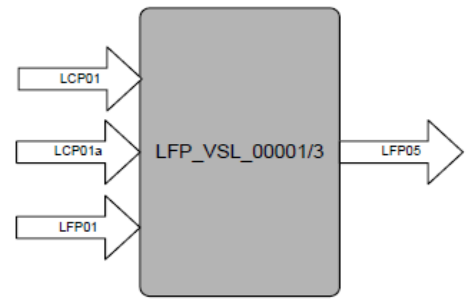
In Black Cell? NO

Chemicals	Unit	Stream ID LFP05 AQUEOUS
Cations (ppm)		
Al^{+3} (Aluminum)	ppm	41,395
Fe^{+3} (Iron)	ppm	49,203
Hg^{+2} (Mercury)	ppm	4
Pb^{+2} (Lead)	ppm	231
Anions (ppm)		
Cl^- (Chloride)	ppm	12,176
CO_3^{-2} (Carbonate)	ppm	119,721
F^- (Fluoride)	ppm	16,991
NO_2^- (Nitrate)	ppm	14,868
NO_3^- (Nitrite)	ppm	66,614
PO_4^{-3} (Phosphate)	ppm	43,694
SO_4^{-2} (Sulfate)	ppm	11,104
$OH(aq)^-$	ppm	22,532
$OH(s)^-$	ppm	12,464
pH		14.29
Suspended Solids	wt%	0
Temperature	°F	150
Liquid Density*	lb/ft3	NA

* Liquid density provided for reference
24590-WTP-DB-PET-09-001

24590-WTP-RPT-PR-04-0001-03, Rev. 0
WTP Process Corrosion Data – Vol. 3

Figure B- 1 LFP-VSL-00001/3 Aqueous PCDS



	Stream ID			
	LCP01	LCP01a	LFP01	LFP05
Properties				
Suspended Solids [wt %]	0	0	0	0
Total Salts [wt %]	33.94	0	79.88	50.07
Sodium Molarity [M]	6.43E+00	0	7.83E-01	4.80E+00
Relative Humidity [%]	n/a	n/a	n/a	n/a
pH	14.07	7.00	7.00	14.29
Anti-Foam Agent [ppm]	7.22E+01	0	0	3.90E+01
TOC [kg/h]	1.46E+00	0	8.84E+00	1.02E+01
Pressure [bar]	0.98	0.99	0.99	0.98
Temperature [C]	77.35	25.00	50.56	65.56
Temperature [F]	171.24	77.00	123.00	150.00
Water Flow Rate [kg/hr]	419.50	15.90	76.11	511.45
Total Aqueous Flow Rate [kg/hr]	635.00	15.90	378.35	1024.26
Total Flow Rate [kg/hr]	6.35E+02	1.59E+01	3.78E+02	1.02E+03
UserNote	VIT LIQUID LAW Concentrate	VIT LIQUID LFP MFPV Line Flush	VIT GLASS FRIT LAW Blended Glass Formers	VIT LIQUID Blended LAW Feed
AQUEOUS				
Cations (ppm)				
Ag+	1	0	0	0
Al+3	7379	0	43135	41395
Am+3	0	0	0	0
As+5	3	0	0	2
B+3	413	0	52628	39854
Ba+2	1	0	0	1
Be+2	0	0	0	0
Bi+3	9	0	0	9
Ca+2	277	0	57242	63103
Cd+2	2	0	3	3
Ce+4	416	0	0	427
Co+2	1	0	0	0
Cr+3	0	0	0	0
Cr+6	367	0	0	576
Cs+	0	0	0	0
Cu+2	1	0	0	1
Eu+3	0	0	0	0
Fe+2	0	0	0	0
Fe+3	447	0	64589	49203
H+	0	0	0	0
Hg+2	1	0	0	4
K+	2228	0	155	1440
La+3	0	0	0	0
Li+	132	0	13743	25563
Mg+2	56	0	15283	22630
Mn+4	5	0	211	502
Mo+6	7	0	0	5
Na+	116630	0	9068	78122
Nd+3	3	0	0	2
Ni+2	29	0	151	235
Pb+2	15	0	1	231
Pd+2	0	0	0	0
Pr+4	0	0	0	0
Pu+4	0	0	0	0
Ra+2	0	0	0	0
Rb+	0	0	0	0
Rh+3	0	0	0	0
Ru+4	1	0	0	1
Sb+3	2	0	0	1
Se+4	8	0	0	6
Si+4	1527	0	324276	299494
Sr+2	37	0	0	25
Ta+5	0	0	0	0
Tc+4	0	0	0	0
Te+4	0	0	0	0
Th+4	0	0	31	23
Ti+4	69	0	14357	10965
Tl+5	8	0	0	5
U+4	0	0	0	0
V+3	1	0	60	46
W+6	2	0	0	1
Y+3	0	0	0	0
Zn+2	250	0	47894	36111
Zr+4	156	0	34207	25754
Anions (ppm)				
B(OH)4-	0	0	0	0
C2O4-2	1492	0	0	1853
Cl-	19805	0	39	12176
CN-	1	0	0	1
CO3-2	14352	0	65721	119721
F-	27670	0	0	16991
H2PO4-	0	0	0	0
H2SiO4-2	0	0	0	0
H3SiO4-	0	0	0	0
HCO3-	0	0	0	0
HPO4-2	0	0	0	0
HSO3-	0	0	0	0
HSO4-	0	0	0	0
I-	0	0	0	0
IO3-	0	0	0	0
NH4+	0	0	0	0
NO2-	22295	0	0	14868
NO3-	82739	0	0	66614
O-2	0	0	0	0
O2-2	0	0	0	0
OH(aq)-	15845	0	0	22532
OH(s)-	9748	0	0	12464
PO4-3	4797	0	330	43694
SO3-2	0	0	0	0
SO4-2	5004	0	215	11104
Organics (ppm)				
AFA_DCMP	2201	0	0	1568
AFA_NVOC	72	0	0	84
NVOC	2591	0	0	21091
Sucrose	186	0	55495	26090
SVOC	64	0	0	561
VOC	24	0	0	268

GENERAL NOTE FOR USE OF PCDS:

- *The information provided by the PCDS report is intended solely for use in support of the vessel material selection process and Corrosion Evaluations. The inputs, assumptions, and computational/engineering models used in generating the results presented herein are specific to this effort. Use of the information presented herein for any other purpose will require separate consideration and analysis to support justification of its use for the desired, alternative purpose.*
- *The process descriptions in this report cover routine process operations and non-routine (infrequent) process operations, when such exist, that could impact corrosion or erosion of process equipment.*
- *The data in the non-shaded columns of the PCDSs has NOT been adjusted to comply with the highest expected, vessel-specific operational conditions.*
- *The process descriptions provided in this report are for general information and reflective of the corrosion engineer's analysis for transparency, the information is current only at the time this document is issued. These process descriptions should not be referenced for design.*

6.1 LAW Melter Feed Preparation Vessel (LFP-VSL-00001/3)

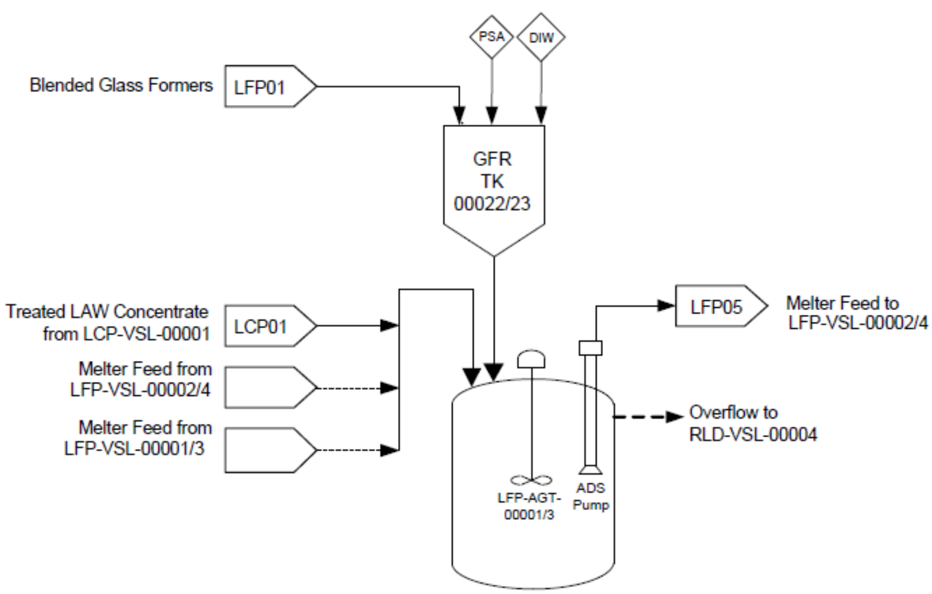
6.1.1 Description of Vessel/Equipment

The Low-Activity Waste (LAW) Melter Feed Process (LFP) system receives LAW concentrate from the LAW Concentrate Receipt Process (LCP) system and mixes the waste with glass formers and sucrose from the Glass Formers Reagent (GFR) system. The mixed melter feed is transferred from the melter feed preparation vessels (MFPVs) to the melter feed vessels (MFVs) where it is pumped to the LAW melters.

LFP-VSL-00001 and LFP-VSL-00003 are the same vessels in every way except that LFP-VSL-00001 is the MFPV for LAW melter 1 and LFP-VSL-00003 is the MFPV for LAW melter 2. Therefore, the stream properties of these vessels will be the same and henceforth they are collectively referred to as LFP-VSL-00001/3. LAW concentrate is received in these vessels at a minimum flowrate of 88 gal/min from LCP-VSL-00001/2 (24590-WTP-DB-ENG-01-001, Ref. 8.1.1(4), Table 6-3). Glass formers are received in LFP-VSL-00001/3 from a glass former mixer enclosure (GFR-TK-00022/23) at a minimum and maximum discharge rate of 132 ft^3/hr and 392 ft^3/hr, respectively (24590-LAW-M0D-GFR-00022/23, Ref. 8.1.5(2) & 8.1.5(3), Page 1).

Figure 18 is a sketch of the input and output arrangement of streams for LFP-VSL-00001/3. Streams that are not primary routes (off-normal or infrequent transfers) are represented with dashed lines.

Figure 18 LFP-VSL-00001/3 Sketch



6.1.2 System Functions

The process functions of this vessel are as follows:

- Receive LAW Concentrate
- Receive Glass Formers
- Mix LAW Concentrate with Glass Formers
- Transfer Blended Melter Feed to MFV

These vessels perform additional system functions beyond the process functions, but these are outside the scope of this document. The non-process functions are not discussed any further in this document. However, they are listed below for completeness:

- Confine Hazardous Materials
- Flush System Components
- Report System Data
- Sample LAW Melter Feed

6.1.3 Description of Process Functions

6.1.3.1 Receive LAW Concentrate

The following process streams taken from Process Flow Diagram 24590-LAW-M5-V17T-00001/2 (Ref. 8.1.3(9) & 8.1.3(10)) and associated drawing change notices (DCNs) 24590-LAW-M5N-V17T-00013 and 24590-LAW-M5N-V17T-00020 are inputs to LFP-VSL-00001/3:

- LCP01 - Treated LAW concentrate from LCP-VSL-00001
- LFP01 - Blended Glass Formers from GFR-VSL-00007 via GFR-TK-00022/23
- Melter Feed from LFP-VSL-00002/4 (off-normal)
- Melter Feed from LFP-VSL-00001/3 (off-normal)

6.1.3.1.1 LCP01 - Treated LAW concentrate from LCP-VSL-00001

Stream LCP01 is the concentrated treated LAW product sent to LFP-VSL-00001/3 from LCP-VSL-00001. The target sodium concentration for stream TLP02 is 5-10M Na (8 to 10 molar sodium for Envelope A and C, and 5 molar for Envelope B) depending on the LAW Envelope being processed (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Section 6.2.2). A maximum specific gravity of 1.4 has been utilized based on potential rheological concerns in LAW Vitrification after the addition of glass forming chemicals. The evaporator is set to a specified concentration which can be changed as the process requires (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Section 4.10.2). Stream TLP02 goes through TCP-VSL-00001 and LCP-VSL-00001, both of which only add flush water.

Molarity
LCP-VSL-00001 adds vessel wash water to dilute the TLP concentrate, and for most feeds, the sodium concentration of LCP01 will range from 5.9 to 6.7 M (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-16). The sodium concentration of TLP02 and LCP01 may range from 5 to 10 M (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Section 6.2.2). Assuming no dilution due to flush water addition, 8 M is the nominal sodium molarity for stream LCP01. The upper bounding sodium molarity is 10 M.

Temperature
The nominal temperature of waste coming from LCP-VSL-00001 is 123°F (24590-LAW-MVC-LCP-00002, Ref. 8.1.4(20), Section 8) and the vessel design temperature where stream LCP01 originates is 150°F (24590-LAW-MVD-LCP-00004, Ref. 8.1.5(10)). Therefore, 123°F is considered nominal temperature and 150°F is considered upper bounding temperature for stream LCP01 (24590-LAW-MVD-LFP-00013, Ref. 8.1.5(13)).

Solids Concentration
The solids concentration for stream LCP01 will normally range from 1.8-2.4 wt% UDS (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-16). The nominal solids concentration is the average of this range, 2.1 wt%. Stream LCP01 will have same solids concentration as stream TCP03, assuming no dilution (due to flush water addition) in LCP-VSL-00001. The upper limit for solids in TCP03 is 3.4 wt% (24590-WTP-RPT-ENG-08-021-04, Ref. 8.1.1(12), Table A-3). However, the maximum operating wt% suspended solids in the concentrate is 3.8 wt% (24590-LAW-MVC-LCP-00002, Ref. 8.1.4(20), Section 8). Therefore, 3.8 wt% is considered upper bounding solids concentration for stream LCP01.

Slurry Density
The slurry density of stream LCP01 will range from 77.2 lb/ft^3 to 81.2 lb/ft^3 (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-16). The normal slurry density is the average of this range, 79.2 lb/ft^3. LCP-VSL-00001 design specific gravity is 1.47 (~91.8 lb/ft^3) and is considered an extreme maximum for stream LCP01 (24590-LAW-MVD-LCP-00004, Ref. 8.1.5(10)).

Slurry pH
Liquid pH is not a controlled parameter for stream LCP01. The pH range given in the PIBOD is 14 to 15 (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-16). The nominal pH for this stream will be provided in the corrosion data sheet.

6.1.3.1.2 Melter Feed from LFP-VSL-00002/4 (off-normal)

Off-spec melter feed from LFP-VSL-00002/4 can be returned to LFP-VSL-00001/3. If the melter feed needs to be transferred back to the Pretreatment Facility plant wash vessel, PWD-VSL-00044 for reprocessing, further dilution can be performed in the PTF plant wash vessel until the solids content is less than 5 wt% (24590-LAW-3YD-LFP-00001, Ref. 8.1.2(2), Section 6.2.1).

This transfer is considered an off-normal, infrequent event. Therefore, this transfer will not be discussed further because it is an off-normal process stream.

6.1.3.1.3 Melter Feed from LFP-VSL-00001/3 (off-normal)

Off-spec waste from melter feed prep vessel LFP-VSL-00003 can be returned to LFP-VSL-00001/3 and vice versa. This transfer is considered an off-normal, infrequent event. Therefore, this transfer will not be discussed further in this document.

6.1.3.2 Receive Glass Formers

6.1.3.2.1 LFP01 - Blended Glass Formers from GFR-TK-00022/23

Stream LFP01 is the blended glass formers sent to LFP-VSL-00001/3 from GFR-TK-00022/23. Bulk glass formers are added from the GFR hoppers and the bulk particles are wetted during transfer to reduce dusting problems. The volume and ratios of glass formers is determined based on the samples drawn from the LCP CRV vessels. High nitrate feed concentrate requires the addition of a reductant in order to control melter foaming. Sugar (sucrose) has been selected as the baseline reductant for WTP and is normally added with the glass formers. Note: other organics in the melter feed will also help to reduce nitrates. Sugar can be reduced accordingly when these are present.

A batch of glass formers tailored to the LAW sample analysis is transferred from a glass former mixer enclosure (GFR-TK-00022/23) to the MFPV. The glass former batch is weighed and checked against the specified amount of glass formers for meeting the target glass composition. The mixture of glass formers is blended before it is delivered to the LAW glass former enclosure and mixed with demineralized water for dust mitigation before it is transferred into the MFPV. Each mixer enclosure may only transfer to a dedicated MFPV.

Molarity
The sodium concentration of LFP01 may range from 0 to 2.9 M (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). The nominal sodium concentration is the average of this range, 1.5 M and the maximum sodium concentration for stream LFP01 is 2.9 M.

Temperature
The temperature of LFP01 ranges from 122°F to 123°F (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). However, the minimum and maximum temperatures for the internal unoccupied C3 area are 59°F and 95°F (24590-WTP-DB-ENG-01-001, Ref. 8.1.1(4), Table 12-1). Therefore the average temperature for stream LFP01 is 77°F (based on the average of minimum and maximum temperatures of the internal unoccupied C3 area) and the maximum temperature is 123°F.

Solids Concentration
The solids will range from 78.3 to 87.7 wt% UDS (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17.) The normal solids concentration is the average of this range, 83.0 wt%. DIW is added to the glass formers to reduce dusting problems. The value ranges from 2.25 wt% water to 4 wt% water (24590-LAW-M4C-20-00002, Ref. 8.1.4(18), Section 6.1.1). Therefore, 87.7 wt% is considered the upper bounding solids concentration for stream LFP01.

Slurry Density
The density of stream LFP01 will normally range from 129 lb/ft^3 to 136 lb/ft^3 (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). Average particle density for blended GFC recipes is 152 lb/ft^3. This is the average density of recipes varying from 149 to 155 lb/ft^3 (24590-LAW-MVC-LFP-00001, Ref. 8.1.4(19), Sheet No. 3) and 155 lb/ft^3 is the upper bounding slurry density for LFP01.

Slurry pH
Liquid pH is not a controlled parameter for stream LFP01. The pH range given in the PIBOD is 7 to 7 (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). The nominal pH for this stream will be provided in the corrosion data sheet.

6.1.3.3 Mix LAW Concentrate with Glass Formers

The glass formers are mixed with the LAW concentrate using mechanical agitation. Each vessel contains one agitator. LAW Melter1/2 Feed Prep Vessel Agitator requirements are provided in 24590-LAW-MFD-LFP-00007 (for LFP-AGT-00001, Ref. 8.1.5(4)) and 24590-LAW-MFD-LFP-00009 (for LFP-AGT-00003, Ref. 8.1.5(6)). Mixing requirements for LFP-VSL-00001/3 are described in 24590-LAW-MPD-LFP-00001 (for LFP-PMP-00001A/B, Ref. 8.1.5(8)) and 24590-LAW-MPD-LFP-00004 (for LFP-PMP-00003A/B, Ref. 8.1.5(9))

6.1.3.4 Transfer Blended Melter Feed to MFV

The following process streams taken from Process Flow Diagram 24590-LAW-M5-V17T-00001/2 (Ref. 8.1.3(9) & 8.1.3(10)) and associated DCNs 24590-LAW-M5N-V17T-00013 and 24590-LAW-M5N-V17T-00020 are outputs from LFP-VSL-00001/3:

- LFP05 - Melter Feed to LFP-VSL-00002/4
- Overflow to RLD-VSL-00004 (off-normal)

6.1.3.4.1 LFP05 - Melter Feed to LFP-VSL-00002/4

Stream LFP05 is the blended feed from the melter feed preparation vessel to the melter feed vessel, LFP-VSL-00002/4. Stream LFP05 is LAW concentrate mixed with glass formers and water to meet the target glass composition. The melter feed prep vessel cannot directly transfer to a non-corresponding melter feed vessel. A sample is drawn from the MFPV to confirm that the glass formers were added in the correct ratios based on the resultant feed composition.

Molarity
The sodium concentration of LFP05 may range from 3.8 to 4.8 M (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). The nominal sodium concentration is the average of this range, 4.3 M and the maximum sodium concentration for stream LFP05 is 4.8 M.

Temperature
LFP-VSL-00001/3 nominal temperature is 130°F (24590-LAW-MVC-LFP-00001, Ref. 8.1.4(19), Section 8). LFP-VSL-00001/3 design temperature, where stream LFP05 originates is 150°F (24590-LAW-MVD-LFP-00010, Ref. 8.1.5(12)). However, a higher temperature range of 196°F to 211°F is reported in PIBOD (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). The high temperature reported in PIBOD is due to high temperature of stream LFP01, mixer heat input, and lack of control of temperature via the cooling jacket. Since MFPVs have cooling jackets (24590-LAW-M6N-20-00004, Ref. 8.1.3(12)), the design temperature of 150°F is considered maximum for stream LFP05.

Solids Concentration
The solids will range from 36.1 to 44.8 wt% UDS (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). The nominal solids concentration for stream LFP05 is the average of this range, 40.5 wt%. A water mass concentration range of 36% - 40 wt% is targeted for this LFP-VSL-00001/3 in order to meet melter feed requirement (24590-WTP-RPT-PO-03-007, Ref. 8.1.1(19), Section 9). Maximum weight % suspended solids based on weight % water in the slurry is 64% (24590-LAW-MVC-LFP-00001, Ref. 8.1.4(19), Section 7.4.1). Therefore, the upper bounding solids concentration for stream LFP05 is 64 wt%.

Slurry Density
The density of stream LFP05 will normally range from 97 lb/ft^3 to 104 lb/ft^3 (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). The normal slurry density is the average of this range, 101 lb/ft^3. LFP-VSL-00001/3. Vessel design specific gravity is 1.9 (~119 lb/ft^3) and is considered an extreme maximum (24590-LAW-MVD-LFP-00010, Ref. 8.1.5(12)).

Slurry pH
Slurry pH for stream LFP05 ranges from 13.5 to 14.5 (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). The nominal pH for this stream will be provided in the corrosion data sheet.

6.1.3.4.2 Overflow to RLD-VSL-00004 (off-normal)

Overflow to RLD-VSL-00004 would have the same properties as LFP05 but is considered an off-normal, infrequent event. Therefore, this transfer will not be discussed further in this document.

6.1.4 Process Modes

6.1.4.1 Normal Operations

Based on the assessment of streams frequently transferred in and out of LFP-VSL-00001/3, Two normal processing modes are considered:

1) Receipt of treated LAW Concentrate Feed from LCP-VSL-00001
2) Receipt of Blended Glass Formers

Section 6.1.5.1 summarizes in tabular form each of these processing modes.

6.1.4.2 Infrequent Operations

The LAW Melter Feed Preparation Vessels (LFP-VSL-00001/3) do not have any infrequent modes of operation. All modes of operation either fall within the definition of normal operations or off-normal operations. Off-normal conditions of operation are not included in this document.

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6.1.5 Summary of Processing Conditions for LFP-VSL-00001/3

6.1.5.1 Normal Operations

The following table summarizes the normal processing mode for vessel LFP-VSL-00001/3 where the vessel receive LAW concentrate from LCP-VSL-00001 and glass formers from GFR-TK-00022/23 and blend the LAW concentrate with the glass formers prior to transfer to melter feed vessel, LFP-VSL-00002/4.

Summary of LFP-VSL-00001/3 Normal Waste Conditions for Processing

Stream Number	Weight % UDS		Na Molarity		Temperature (°F)	
	normal	upper	normal	upper	normal	upper
LCP01	2.1	3.8	8	10	123	150
LFP01	83.0	87.7	1.5	2.9	77	123
LFP05	40.5	64.0	4.3	4.8	130	150

6.1.5.2 Infrequent Operations

None identified.

CORROSION EVALUATION

LFP-VSL-00002 & LFP-VSL-00004
Melter 1 & 2 Feed Vessels

Appurtenances
LFP-AGT-00002, LFP-AGT-00004

Contents of this document are Dangerous Waste Permit affecting

Results

Materials Considered

Material (UNS No.)	Acceptable Material
Type 304L (S30403)	
Type 316L (S31603)	X
AL-6XN® 6% Mo (N08367)	X
Hastelloy® C-22® (N06022)	X
Stellite® 12 (R30012)	X (agitator impellor only)

Recommended Material Types:
Vessel head/shell – Type 316 (max 0.030%C; dual certified)
Vessel support – Type 304 or 316 (max 0.030% C; dual certified)
Internal piping – Type 316 (max 0.030% C; dual certified)
Agitator impeller: Stellite® 12 or equivalent

Minimum Corrosion Allowance:
0.04 inch required on top head (includes 0.024 inch corrosion allowance and 0.016 inch general erosion allowance)
0.125 inch required on bottom head and shell (includes erosion and corrosion)

Inputs and References

- Operating temperature (°F) (nom/max): 98/123 (24590-LAW-MVC-LFP-00001)
- Uniform corrosion allowance (inch): 0.024 (24590-WTP-DB-ENG-01-001)
- Uniform erosion allowance (inch): 0.016 (24590-WTP-DB-ENG-01-001)
- Vessel bottom design corrosion allowance (inch): 0.125 (24590-WTP-M0C-50-00004)
- Location: Rooms L-0123 & L-0124 (24590-LAW-P1-P01T-00002)
- Operating conditions are as stated in the applicable section of *WTP Process Corrosion Data – Volume 3* (24590-WTP-RPT-PR-04-0001-03)

Assumptions and Supporting Justifications (see Section 19, References)

- Source data presented on the PCDS are conservative with respect to corrosion as stated therein.[10]
- The feed vessels have cooling jackets to control contents temperature.[10]
- Vessels are equipped with a mechanical agitator to continuously mix the vessel contents to keep insoluble solids in suspension.[1]

Operating Restrictions:

- To protect against localized corrosion in the vessel and transfer piping, develop procedure to bring the vessel contents to within the limits defined for Type 316L in 24590-WTP-DB-ENG-01-001, *Basis of Design,* in the event that temperature, pH, or chloride concentration exceeds those limits.
- Develop a procedure to control, at a minimum, cleaning, rinsing, and flushing of vessel and internals, as applicable.
- Develop procedure to control lay-up and storage; includes both before plant is operational and during inactive periods after start-up.
- Procedures are to be reviewed and accepted by MET prior to use.

Concurrence TD
Operations

3	3/29/19	Revised to include pages that were not included with issued document. No technical changes have been made from Rev 2 to Rev 3	Originator By: Dr. Robert Davis - rbdavis Org Name: Bechtel Placed: Feb 01, 2019 RBDavis	Checked MFang	REVIEWED APRangus	JLJulyk
REV	**DATE**	**REASON FOR REVISION**	**ORIGINATE**	**CHECK**	**REVIEW**	**APPROVE**

CORROSION EVALUATION

REVISION HISTORY

REV	DATE	REASON FOR REVISION	ORIGINATE	CHECK	REVIEW	APPROVE
2	11/14/18	Include Stellite 12 in Materials Considered Update references Include DFLAW configuration discussion	DLAdler	MFang	RBDavis	JLJulyk
1	3/23/16	Complete re-write; no rev bars shown New format Incorporate updated PCDS Update references	DLAdler	TRangus	RBDavis	TErwin
0	11/14/04	Initial Issue Vessels removed from 24590-LAW-N1D-LFP-00006 due to new Process Corrosion data	DLAdler	JRDivine	APR	APRangus

This bound document contains a total of 14 sheets.

CORROSION EVALUATION

Corrosion/Erosion Detailed Discussion

The Low-Activity Waste (LAW) Melter Feed Process (LFP) system receives LAW concentrate from the LAW Concentrate Receipt Process (LCP) system and mixes the waste with glass formers and sucrose from the Glass Formers Reagent (GFR) system. The mixed melter feed is transferred from the melter feed preparation vessels (MFPV) to the melter feed vessels (MFV) where it is pumped to the LAW melters.

LFP-VSL-00002 and LFP-VSL-00004 are the same vessels in every way except that LFP-VSL-00002 is the MFV for LAW train 1 and LFP-VSL-00004 is the MFV for LAW train 2. Therefore, the stream properties of these vessels will be the same and are collectively referred to as LFP-VSL-00002/4. The MFVs receive blended melter feed from MFPVs for feed to the corresponding LAW melter via the air displacement slurry (ADS) pumps. ADS pumps provide the melter with a continuous and consistent feed rate, which is not impacted during the batch transfers from MFPV to the MFV.

Where the pages of the attached PCDS report refer to transfers between LAW and PT facilities, those transfers are available only during baseline configuration and are isolated during DFLAW configuration. Under the DFLAW configuration, effluent concentrate is transferred from DEP-VSL-00003A/B/C to LCP-VSL-00001/2. In the unlikely event that an off-spec batch is generated, the off-spec batch can be returned to the Tank Farms via the LAW radioactive liquid waste disposal (RLD) system, the Direct Feed LAW Effluent Management Facility Process System (DEP), and the underground transfer lines.

1 General/Uniform Corrosion Analysis

a Background

General or uniform corrosion is corrosion that is distributed uniformly over the surface of a material without appreciable localization. This leads to relatively uniform thinning on sheet and plate materials and general thinning on one side or the other (or both) for pipe and tubing. It is recognized by a roughening of the surface and usually by the presence of corrosion products. The mechanism of the attack is an electrochemical process that takes place at the surface of the material. Differences in composition or orientation between small areas on the metal surface create anodes and cathodes that facilitate the corrosion process.

b Component-Specific Discussion

This vessel receives blended feed (LAW concentrate mixed with glass formers). The normal pH, chloride concentration, and temperatures are such that Type 316L stainless steel will be acceptable. The solution is normally constantly mixed using mechanical agitators and sampling is performed. The uniform corrosion rate is low under these conditions. Based on 24590-WTP-M0C-50-00004, *Wear Allowance for WTP Waste Slurry Systems*, 0.040 inch corrosion allowance is sufficient for the top head of the vessel, not impacted by the erosion caused by the mechanical agitators in slurry with glass former service. For conservatism, in vessels containing mechanical agitators, a design corrosion allowance of 0.125 inch should be used for the vessel bottoms to provide a 40-year service life in waste slurries with glass formers.

Evaluation of the cooling jackets is documented in 24590-LAW-N1D-LFP-00001.

2 Pitting Corrosion Analysis

Pitting is localized corrosion of a metal surface that is confined to a point or small area and takes the form of cavities. Dillon (2000) states that in alkaline solutions, pH>12, chlorides are likely to promote pitting only in tight crevices such as might form after partial removal of deposits during multiple rinse cycles. At temperatures up to 150 °F, both Type 304L and Type 316L stainless steel would be acceptable in the proposed alkaline waste.

The chemistry and operating conditions in this vessel fall within the limits established for 300 series stainless steel in Table 18-1 of 24590-WTP-DB-ENG-01-001, *Basis of Design* . For convenience, this comparison is documented on page 6 of this corrosion evaluation.

3 Crevice Corrosion Analysis

Crevice corrosion is a form of localized corrosion of a metal or alloy surface at, or immediately adjacent to, an area that is shielded from full exposure to the environment because of close proximity of the metal or alloy to the surface of another material or an adjacent surface of the same metal or alloy. Crevice corrosion is similar to pitting in mechanism. Crevices in this vessel are limited by the design and fabrication practice.

The chemistry and operating conditions in this vessel fall within the limits established for 300 series stainless steel in Table 18-1 of 24590-WTP-DB-ENG-01-001.

4 Stress Corrosion Cracking Analysis

Stress corrosion cracking (SCC) is the cracking of a material produced by the combined action of corrosion and sustained tensile stress (residual or applied). The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, and the environment; also chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even concentrations as low as 10 ppm can lead to cracking under some conditions.

The chemistry and operating conditions in this vessel fall within the limits established for 300 series stainless steel in Table 18-1 of 24590-WTP-DB-ENG-01-001.

5 End Grain Corrosion Analysis

End grain corrosion is preferential corrosion which occurs along the worked direction of wrought stainless steels exposed to highly oxidizing acid conditions. End grain corrosion is exclusive to metallic product forms with exposed end grains from shearing or mechanical cutting and only occurs when exposed end grains are exposed to highly oxidizing acid conditions. Such conditions are not present in this vessel; therefore, end grain corrosion is not a concern.

6 Weld Corrosion Analysis

The welds used in the fabrication will follow the WTP specifications and standards for quality workmanship. The materials selected for this fabrication are compatible with the weld filler metals and ASME/ AWS practice. Using the welding practices specified for the project there should not be gross micro-segregation, precipitation of secondary phases, formation of unmixed zones, or volatilization of the alloying elements that could lead to localized corrosion of the weld. Assuming that correct weld procedures are followed, no preferential corrosion of weld beads or heat-affected zones occurs in the expected aqueous chemistry and temperature.

7 Microbiologically Influenced Corrosion Analysis

Microbiologically influenced corrosion (MIC) refers to corrosion affected by the presence or activity, or both, of microorganisms. Typically, with the exception of cooling water systems, MIC is not observed in operating systems. In this system, the proposed operating conditions are not conducive to microbial growth. Rinsing with untreated process water may be a concern. The use of demineralized water for rinsing is recommended. Conditions that lead to MIC are not present in this system.

Evaluation of the cooling jackets is documented in 24590-LAW-N1D-LFP-00001.

8 Fatigue/Corrosion Fatigue Analysis

Fatigue is the process of progressive localized permanent structural change occurring in a material subjected to fluctuating stresses at less than the ultimate tensile strength of the material. Corrosion fatigue is the process wherein a metal fractures prematurely under conditions of simultaneous corrosion and repeated cyclic loading at lower stress levels or fewer cycles than would be required to cause fatigue of that metal in the absence of the corrosive environment. Based on the anticipated low mechanical and thermal cycling (Attachment C of 24590-WTP-MVC-50-00009, *Lab, BOF, and LAW Vessel Cyclic Datasheet Inputs*), it can be stated that conditions which lead to fatigue or corrosion fatigue are not present in this vessel.

9 Vapor Phase Corrosion Analysis

Conditions in the vapor phase and at the vapor/liquid interface can be different than those present in the liquid. The vapor space corrosion is self-limiting due to the passive film. Also, the layers of deposited corrosion product on top of the passive film act as barriers that reduce mass transport necessary for corrosion. Corrosion rates of materials exposed to vapors in the headspace are never greater than the corrosion during immersion service. The corrosion at the liquid air interface (LAI) is an oxygen-concentration cell resulting from the alternate wetting and drying occurring at the interface. Vessels that operate at the same liquid level and form a surface crust are more susceptible to LAI corrosion. Corrosion at the LAI could be similar to immersion service and not usually greater. WTP vessels also have the protective passive film at the LAI which reduces corrosion and the liquid level is constantly changing. As compared to the corrosion in the immersion section, the corrosion rates in the vapor space are much lower. Vapor phase corrosion is not a concern.

10 Erosion Analysis

Erosion is the progressive loss of material from a solid surface resulting from fluid flow. The material loss is caused by mechanical interaction between the surface and the fluid, as the velocity increases the material loss increases. When the fluid contains a second phase, “two phase solution”, erosion rates increase rapidly. The second phase material can be solid particles like sand or air/steam bubbles. WTP is more concerned with the solid particle impingement; the solid particles are generally oxides of waste.

The slurry velocity on the vessels’ sides and bottoms will be proportional to the tip speed of the agitator blades. Based on 24590-WTP-M0C-50-00004, velocities at the walls and bottom of the vessels are expected to be below 10 ft/s. For conservatism, a design corrosion allowance of 0.125 inch, based on a velocity of 10 ft/s, should be used for the vessel bottoms to provide a 40-year service life.

As stated in 24590-WTP-3PS-MACS-T0003, *Engineering Specification for Mechanical Agitators*, the agitator blades shall be cast cobalt-based Stellite® 12, which demonstrates heightened wear resistance (Stellite® 12 Alloy Technical Data Publication, Kennametal, Inc.). Based on the use of wear resistant materials, and the fact that the agitators are maintainable and replaceable, no erosion allowance is specified.

11 Galling of Moving Surfaces Analysis

Where two metals are moving in contact with each other without lubrication, there is a risk of damage to their surfaces. No moving unlubricated surfaces are present within the vessel; therefore, galling is not a concern.

12 Fretting/Wear Analysis

Fretting corrosion refers to corrosion damage caused by a slight oscillatory slip between two surfaces. Similar to galling but at a much smaller movement, the corrosion products and metal debris break off and act as an abrasive between the surfaces, producing a classic three-body wear problem. This damage is induced under load and repeated relative surface motion. Conditions which lead to fretting are not present in this vessel; therefore, fretting is not a concern.

CORROSION EVALUATION

13 Galvanic Corrosion Analysis

Galvanic corrosion is accelerated corrosion caused by the potential difference between the two dissimilar metals in an electrolyte. The galvanic current is sufficient to drive corrosion when the potential difference is greater than 200 mV. One material becomes the anode and the other the cathode. Corrosion occurs on the anode material at the interface where the potential gradient is the greatest. A potential difference of more than 200 mV is needed for a sufficient driving force to initiate galvanic corrosion. The potential difference for any combination of alloys used in the vessel design is not sufficient for galvanic currents to overcome the passive protective film. For such alloys, there is negligible potential difference so galvanic corrosion is not a concern.

14 Cavitation Analysis

Cavitation is the formation and rapid collapse of cavities or bubbles of vapor or gas within a liquid resulting from mechanical or hydrodynamic forces. Cavitation is typically associated with pumps and orifice plates, not vessels. The agitator blade is susceptible to cavitation. For this reason, agitators are replaceable components. To avoid excessive maintenance, a Stellite® alloy has been selected for the agitator blades. The cobalt-chromium alloy offers resistance to cavitation damage. This alloy also possesses high tensile strength comparable to many duplex stainless steels combined with excellent impact toughness and ductility.

15 Creep Analysis

Creep is time-dependent strain occurring under stress and is described as plastic flow, yielding at stresses less than the yield strength. Creep is only experienced during operations at high temperatures. Temperatures much greater than one half the absolute melting temperature of the alloy are necessary for thermally-activated creep to become a concern. The vessel operating and design temperatures are too low to lead to creep; therefore creep is not a concern.

16 Inadvertent Nitric Acid Addition

At this time, the design does not provide for the regular use of nitric acid reagent in this system. Addition of nitric acid into the system would require operator intervention to complete the routing. Nitric acid is a known inhibitor solution, and at the operating temperatures listed, the presence of nitric acid is not a concern.

17 Conclusion and Justification

The conclusion of this evaluation is that LFP-VSL-00002 and LFP-VSL-00004 can be fabricated from a 300 series stainless steel and is capable of providing 40 years of service. Based on the expected operating conditions, a 300 series stainless steel is expected to be satisfactorily resistant to uniform and localized corrosion. Based on 24590-WTP-DB-ENG-01-001, the probable loss due to uniform corrosion over 40 years is 0.024 inch. A design corrosion allowance of 0.04 inch is recommended for the top head (unaffected by the mechanical agitator) and exceeds the corrosion and erosion allowances identified in 24590-WTP-M0C-50-00004 and 24590-WTP-RPT-M-04-0008, *Evaluation of Stainless Steel and Nickel Alloy Wear Rates in WTP Waste Streams at Low Velocities.*

Based on comparison of the process conditions documented in 24590-WTP-RPT-PR-04-0001-03 against the limits for Type 316L documented in 24590-WTP-DB-ENG-01-001, the PCDS values, which take into account conditions at contract maximum values, are within the applicable limits.

Additional localized protection for the bottom head and shell will accommodate wear due to the mechanical agitators and is based on 24590-WTP-M0C-50-00004.

18 Margin

The uniform corrosion allowance for slurry with glass formers is 0.125 inch (0.04 inch corrosion allowance otherwise) based on the range of inputs, system knowledge, handbooks, literature, and engineering judgment/experience. The service conditions described above result in a predicted uniform loss due to uniform corrosion of 0.024 inches. The specified minimum corrosion allowance (0.04 inch for top head and 0.125 inch for bottom head and shell) equals or exceeds the minimum required corrosion allowance specified in the input calculations; therefore, margin is provided. The uniform corrosion design margin for the operating conditions is sufficient to expect a 40 year operating life and is justified in the referenced calculations.

The localized corrosion margin is based on comparison of the process conditions documented in 24590-WTP-RPT-PR-04-0001-03 against the limits for Type 316L documented in 24590-WTP-DB-ENG-01-001. The PCDS values, which take into account conditions at contract maximum values, are within the applicable limits.

Localized protection for the bottom head and shell (0.125 inch) will accommodate wear due to the mechanical agitator. The localized erosion design margin is documented and justified in the referenced calculation (24590-WTP-M0C-50-00004) and is sufficient to expect a 40 year operating life.

The maximum operating parameters for this vessel are defined in the PCDS. As shown in the table on the following page, the PCDS calculated pH, chemistry, and temperature are bounded by the materials localized corrosion design limits documented in the WTP Materials Localized Corrosion Design Limits in Table 18-1 of the *Basis of Design*. The difference between the design limits and the operating maximums (PCDS value) is the localized corrosion design margin and, based on the operating conditions, is sufficient to expect a 40 year operating life. The Melter 1 & 2 Feed Vessels, LFP-VSL-00002 & LFP-VSL-00004, are protected from localized corrosion (pitting, crevice corrosion, and stress corrosion cracking) by operating within the range of the design limits. Operational and process restrictions will be used to ensure the limits are maintained.

CORROSION EVALUATION

MATERIALS LOCALIZED CORROSION DESIGN LIMITS – Type 316L					
	Temperature (°F)	**pH**	**Chloride (molar)**	**Hydroxide (molar)**	**Cl^-/OH^- (molar)**
DESIGN LIMIT	**150 max**	**≥ 10**	**NA**	**NA**	**≤ 2**
Melter feed to LMP-MLTR-00001/2 (LFP04)	150	14.3	3.5E-01	1.9E+00	0.179
Inlet Vessels to LVP-VSL-00002/4	**Temperature (°F)**	**pH**	**Chloride (molar)**	**Hydroxide (molar)**	**Cl^-/OH^- (molar)**
DESIGN LIMIT	**150 max**	**≥ 10**	**NA**	**NA**	**≤ 2**
Melter feed from LFP-VSL-00001/3 (LFP05)	150	14.3	3.4E-01	1.9E+00	0.176

NA = not applicable; no design limit for these values

Inlet vessel to LFP VSL-00002/4 based on 24590-WTP-RPT-PR-04-0001-03, Section 6.2, and Figure 19.

References sources for this table:

1) Design limits - 24590-WTP-DB-ENG-01-001, Table 18-1
2) LFP VSL-00001/3 (LFP05) – 24590-WTP-RPT-PR-04-0001-03, Figure B-1

19 References

1. 24590-LAW-3ZD-LFP-00001, *LAW Melter Feed Process (LFP) and Concentrate Receipt Process (LCP) System Design Description*.
2. 24590-LAW-MVC-LFP-00001, *LAW Melter Feed Process System (LFP) Data with ECCN 24590-LAW-MVE-LFP-00001*.
3. 24590-LAW-N1D-LFP-00001, *LFP-HX-00001/2/3/4 (LAW) - Corrosion Evaluation*.
4. 24590-LAW-P1-P01T-00002, *LAW Vitrification Building General Arrangement Plan at El. 3 Feet-0 Inches*.
5. Deleted
6. 24590-WTP-M0C-50-00004, *Wear Allowance for WTP Waste Slurry Systems with ECCN 24590-WTP M0E-50-00012.*
7. 24590-WTP-MVC-50-00009, *Lab, BOF, and LAW Vessel Cyclic Datasheet Inputs.*
8. 24590-WTP-RPT-M-04-0008, *Evaluation of Stainless Steel and Nickel Alloy Wear Rates in WTP Waste Streams at Low Velocities.*
9. Deleted
10. 24590-WTP-RPT-PR-04-0001-03, *WTP Process Corrosion Data-Volume 3*
11. 24590-WTP-3PS-MACS-T0003, *Engineering Specification for Mechanical Agitators*.
12. 24590-WTP-DB-ENG-01-001, *Basis of Design*.
13. Dillon, CP (Nickel Development Institute), Personal Communication to J R Divine (ChemMet, Ltd., PC), 3 Feb 2000.
14. Kennemetal, Inc., Stellite® 12 Alloy Technical Data Publication. Kennemetal Inc, Indiana.

Additional Reading

- 24590-LAW-MFD-LFP-00008, *24590-LAW-MF-LFP-AGT-00002 - LAW Melter 1 Feed Vessel Agitator*.
- 24590-LAW-MVD-LFP-00007, Rev. 003, *Mechanical Data Sheet - 24590-LAW-LFP-VSL-00002 - Melter 1 Feed Vessel*.
- 24590-LAW-MVD-LFP-00008, Rev. 003, *Mechanical Data Sheet - 24590-LAW-LFP-VSL-00004 - Melter 2 Feed Vessel.*
- 24590-QL-POA-MFA0-00001-09-00018, *Data Sheet - Mechanical Systems Data Sheet - Agitator Mixer*.
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- Miles RE, 2001, Telecon to JR Divine, *LAW and HLW Gamma Radiation Exposures Estimates*, RPP-WTP, Richland, WA 99352.
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CORROSION EVALUATION

PROCESS CORROSION DATA SHEET (extract)

Component(s) (Name/ID #) **LAW Melter Feed Preparation Vessels (LFP-VSL-00002/4)**

Facility **LAW**

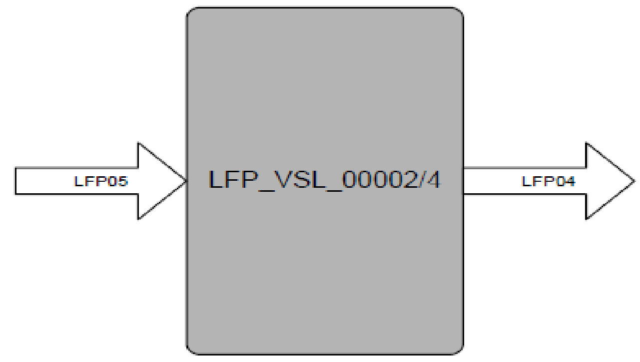
In Black Cell? **NO**

Chemicals	Unit	Stream ID LFP04 AQUEOUS
Cations (ppm)		
Al^{+3} (Aluminum)	ppm	41,945
Fe^{+3} (Iron)	ppm	49,857
Hg^{+2} (Mercury)	ppm	4
Pb^{+2} (Lead)	ppm	235
Anions (ppm)		
Cl^{-} (Chloride)	ppm	12,359
CO_3^{-2} (Carbonate)	ppm	121,312
F^{-} (Fluoride)	ppm	17,248
NO_2^{-} (Nitrate)	ppm	15,081
NO_3^{-} (Nitrite)	ppm	67,570
PO_4^{-3} (Phosphate)	ppm	44,344
SO_4^{-2} (Sulfate)	ppm	11,253
$OH(aq)^{-}$	ppm	22,150
$OH(s)^{-}$	ppm	12,645
pH		14.29
Suspended Solids	wt%	0
Temperature	°F	150
Liquid Density*	lb/ft3	NA

* Liquid density provided for reference
24590-WTP-DB-PET-09-001

Figure B- 3 LFP-VSL-00002/4 Aqueous PCDS

	Stream ID	
	LFP05	LFP04
Properties		
Suspended Solids [wt %]	0	0
Total Salts [wt %]	50.07	50.60
Sodium Molarity [M]	4.80E+00	4.90E+00
Relative Humidity [%]	n/a	n/a
pH	14.29	14.29
Anti-Foam Agent [ppm]	3.90E+01	3.47E+01
TOC [kg/hr]	1.02E+01	1.01E+01
Pressure [bar]	0.98	0.98
Temperature [C]	65.56	65.56
Temperature [F]	150.00	150.00
Water Flow Rate [kg/hr]	511.45	491.02
Total Aqueous Flow Rate [kg/hr]	1024.26	994.94
Total Flow Rate [kg/hr]	1.02E+03	9.96E+02
UserNote	VIT LIQUID Blended LAW Feed	VIT LIQUID Blended LAW Melter Feed to Melter
AQUEOUS		
Cations (ppm)		
Ag+	0	0
Al+3	41395	41945
Am+3	0	0
As+5	2	2
B+3	39854	40061
Ba+2	1	1
Be+2	0	0
Bi+3	9	9
Ca+2	63103	63942
Cd+2	3	3
Ce+4	427	434
Co+2	0	0
Cr+3	0	0
Cr+6	576	584
Cs+	0	0
Cu+2	1	1
Eu+3	0	0
Fe+2	0	0
Fe+3	49203	49857
H+	0	0
Hg+2	4	4
K+	1440	1461
La+3	0	0
Li+	25563	25903
Mg+2	22630	22931
Mn+4	502	509
Mo+6	5	5
Na+	78122	79340
Nd+3	2	2
Ni+2	235	238
Pb+2	231	235
Pd+2	0	0
Pr+4	0	0
Pu+4	0	0
Ra+2	0	0
Rb+	0	0
Rh+3	0	0
Ru+4	1	1
Sb+3	1	1
Se+4	6	6
Si+4	299494	301048
Sr+2	25	25
Ta+5	0	0
Tc+4	0	0
Te+4	0	0
Th+4	23	24
Ti+4	10965	11111
Tl+5	5	5
U+4	0	0
V+3	46	46
W+6	1	1
Y+3	0	0
Zn+2	36111	36591
Zr+4	25754	26096
Anions (ppm)		
B(OH)4-	0	0
C2O4-2	1853	1880
Cl-	12176	12359
CN-	1	1
CO3-2	119721	121312
F-	16991	17248
H2PO4-	0	0
H2SiO4-2	0	0
H3SiO4-	0	0
HCO3-	0	0
HPO4-2	0	0
HSO3-	0	0
HSO4-	0	0
I-	0	0
IO3-	0	0
NH4+	0	0
NO2-	14868	15081
NO3-	66614	67570
O-2	0	0
O2-2	0	0
OH(aq)-	22532	22150
OH(s)-	12464	12645
PO4-3	43694	44344
SO3-2	0	0
SO4-2	11104	11253
Organics (ppm)		
AFA_DCMP	1568	1594
AFA_NVOC	84	75
NVOC	21091	21372
Sucrose	26090	26465
SVOC	561	568
VOC	268	271



GENERAL NOTE FOR USE OF PCDS:

- *The information provided by the PCDS report is intended solely for use in support of the vessel material selection process and Corrosion Evaluations. The inputs, assumptions, and computational/engineering models used in generating the results presented herein are specific to this effort. Use of the information presented herein for any other purpose will require separate consideration and analysis to support justification of its use for the desired, alternative purpose.*
- *The process descriptions in this report cover routine process operations and non-routine (infrequent) process operations, when such exist, that could impact corrosion or erosion of process equipment.*
- *The data in the non-shaded columns of the PCDSs has NOT been adjusted to comply with the highest expected, vessel-specific operational conditions.*
- *The process descriptions provided in this report are for general information and reflective of the corrosion engineer's analysis for transparency, the information is current only at the time this document is issued. These process descriptions should not be referenced for design.*

6.2 LAW Melter Feed Preparation Vessels (LFP-VSL-00002/4)

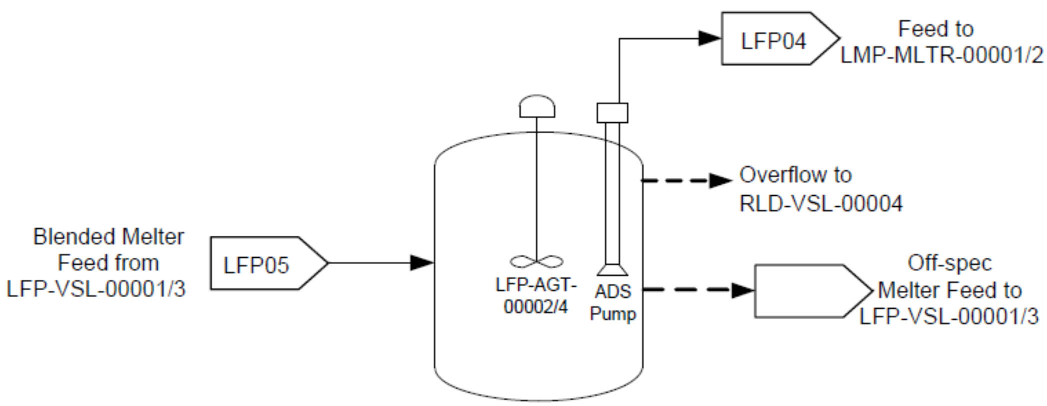
6.2.1 Description of Vessel/Equipment

The Low-Activity Waste (LAW) Melter Feed Process (LFP) system receives LAW concentrate from the LAW Concentrate Receipt Process (LCP) system and mixes the waste with glass formers and sucrose from the Glass Formers Reagent (GFR) system. The mixed melter feed is transferred from the melter feed preparation vessels (MFPVs) to the melter feed vessels (MFVs) where it is pumped to the LAW melters.

LFP-VSL-00002 and LFP-VSL-00004 are the same vessels in every way except that LFP-VSL-00002 is the MFV for LAW train 1 and LFP-VSL-00004 is the MFV for LAW train 2. Therefore, the stream properties of these vessels will be the same and henceforth they are collectively referred to as LFP-VSL-00002/4. The MFVs receive blended melter feed from MFPVs for feed to the corresponding LAW melter (LMP-MLTR-00001 or LMP-MLTR-00002) via the ADS pumps. ADS pumps provide the melter with a continuous and consistent feed rate, which is not impacted during the batch transfers from MFPV to the MFV.

Figure 19 is a sketch of the input and output arrangement of streams for LFP-VSL-00002/4. Streams that are not primary routes (off-normal or infrequent transfers) are represented with dashed lines.

Figure 19 LFP-VSL-00002/4 Sketch



6.2.2 System Functions

The process functions of this vessel are as follows:

- Receive Blended Melter Feed from Melter Feed Prep Vessel
- Store and Mix Melter Feed
- Transfer Melter Feed Slurry to Melter

These vessels perform additional system functions beyond the process functions, but these are outside the scope of this document. The non-process functions are not discussed any further in this document. However, they are listed below for completeness:

- Confine Hazardous Materials
- Flush System Components
- Report System Data
- Sample LAW Melter Feed

6.2.3 Description of Process Functions

6.2.3.1 Receive Blended Melter Feed from MFPV

The following process streams taken from Process Flow Diagram 24590-LAW-M5-V17T-00001/2 (Ref. 8.1.3(9) & 8.1.3(10)) and associated drawing change notices (DCNs) 24590-LAW-M5N-V17T-00013 and 24590-LAW-M5N-V17T-00020 are inputs to LFP-VSL-00002/4:

- LFP05 - Blended Melter Feed from LFP-VSL-00001/3

6.2.3.1.1 LFP05 - Blended Melter Feed from LFP-VSL-00001/3

Stream LFP05 is the blended feed from the melter feed preparation vessel to the melter feed vessel, LFP-VSL-00002/4. Stream LFP05 is LAW concentrate mixed with glass formers and water to meet the target the glass composition. The melter feed prep vessel cannot directly transfer to a non-corresponding melter feed vessel. A sample is drawn from the MFPV to confirm that the glass formers were added in the correct ratios based on the resultant feed composition.

Molarity
The sodium concentration of LFP05 may range from 3.8 to 4.8 M (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). The nominal sodium concentration is the average of this range, 4.3 M and the maximum sodium concentration for stream LFP05 is 4.8 M.

Temperature
LFP-VSL-00001/3 nominal temperature is 130°F (24590-LAW-MVC-LFP-00001, Ref. 8.1.4(19), Section 8). LFP-VSL-00001/3 design temperature, where stream LFP05 originates is 150°F (24590-LAW-MVD-LFP-00010, Ref. 8.1.5(12)). However, a higher temperature range of 196°F to 211°F is reported in PIBOD (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). Since these vessels have cooling jackets (24590-LAW-M6N-20-00004, Ref. 8.1.3(12)), the design temperature of 150°F is considered maximum for stream LFP05.

Solids Concentration
The solids concentration range in the PIBOD is 36.1 to 44.8 wt% UDS (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). The nominal solids concentration for stream LFP05 is the average of this range, 40.5 wt%. A water mass concentration range of 36% - 40 wt% is targeted for this LFP-VSL-00001/3 in order to meet melter feed requirement (24590-WTP-RPT-PO-03-007, Ref. 8.1.1(19), Section 9). Maximum weight % suspended solids based on weight % water in the slurry is 64% (24590-LAW-MVC-LFP-00001, Ref. 8.1.4(19), Section 7.4.1). Therefore, the upper bounding solids concentration for stream LFP05 is 64 wt%.

Slurry Density
The density of stream LFP05 will normally range from 97 lb/ft^3 to 104 lb/ft^3 (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). The normal slurry density is the average of this range, 101 lb/ft^3. LFP-VSL-00001/3 vessel design specific gravity is 1.9 (~119 lb/ft^3) and is considered an extreme maximum (24590-LAW-MVD-LFP-00010, Ref. 8.1.5(12)).

Slurry pH
Slurry pH for stream LFP05 ranges from 13.5 to 14.5 (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). The nominal pH for this stream will be provided in the corrosion data sheet.

6.2.3.2 Store and Mix Melter Feed

The vessel contents are mixed using mechanical agitation. The mechanical agitator continuously mixes the vessel contents to keep insoluble solids in suspension. Each vessel contains one agitator. LAW Melter 1/2 Feed Vessel Agitator requirements are provided in 24590-LAW-MFD-LFP-00008 (for LFP-AGT-00002, Ref. 8.1.5(5)) and 24590-LAW-MFD-LFP-00010 (for LFP-AGT-00004, Ref. 8.1.5(7)). Mixing requirements for LFP-VSL-00002/4 are described in 24590-LAW-MPD-LFP-00003/6 (for LFP-PMP-00002/4).

Sampling the MFVs is not a routine operation. The vessels will be sampled during start-up and commissioning to confirm the glass formers were successfully added and the agitator system is functioning properly. Vessels may also be sampled during production for tracking melter feed composition (24590-LAW-3YD-LFP-00001, Ref. 8.1.2(2), Section 7.2.8).

Off-spec melter feed should be diluted down with demineralized water in the MFV as much as possible. If the melter feed needs to be transferred back to the Pretreatment facility plant wash vessel (PWD-VSL-00044) for reprocessing, further dilution can be performed in the LAW plant wash vessel until the solids content is adjusted properly (24590-LAW-3YD-LFP-00001, Ref. 8.1.2(2), Section 6.2.2).

6.2.3.3 Transfer Melter Feed Slurry to the Melter

The following process streams taken from Process Flow Diagram 24590-LAW-M5-V17T-00001/2 (Ref. 8.1.3(9) & 8.1.3(10)) and associated DCNs 24590-LAW-M5N-V17T-00013 and 24590-LAW-M5N-V17T-00020 are outputs from LFP-VSL-00002/4:

- LFP04 - Melter Feed to LMP-MLTR-00001
- Overflow to RLD-VSL-00004 (off-normal)
- Off-spec Melter Feed to LFP-VSL-00001/3

6.2.3.3.1 LFP04 - Melter Feed to LMP-MLTR-00001/2

LFP-VSL-00002/4 provide continuous blended feed to the LAW melter. Stream LFP04 is the blended feed from the melter feed vessel to the LAW melter LMP-MLTR-00001/2. The melter feed vessel cannot directly transfer to a non-corresponding melter (i.e., LFP-VSL-00002 can transfer to LMP-MLTR-00001 and LFP-VSL-00004 can transfer to LMP-MLTR-00002 but not vice versa).

Molarity
The sodium concentration of LFP04 may range from 3.9 to 4.9 M (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). The nominal sodium concentration is the average of this range, 4.4 M and the maximum sodium concentration for stream LFP04 is 4.9 M.

Temperature
The nominal MFV temperature is 137°F (24590-LAW-MVC-LFP-00001, Ref. 8.1.4(19), Section 8). LFP-VSL-00002/4 design temperature, where stream LFP04 originates is 150°F (24590-LAW-MVD-LFP-00007, Ref. 8.1.5(11)). Therefore, 150°F is the maximum temperature for stream LFP04. Cooling Jackets have been added in P&ID DCN 24590-LAW-M6N-20-0004. However, a higher temperature range of 217°F to 220°F is reported in PIBOD (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). The high temperature reported in PIBOD is due to high temperature of stream LFP05 and lack of control of temperature via cooling jacket.

Solids Concentration
The solids will range from 36.3 to 45.4 wt% UDS (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). The nominal solids concentration for stream LFP04 is the average of this range, 40.9 wt%. A water mass concentration range of 36% - 40 wt% is targeted for this LFP-VSL-00001/3 in order to meet melter feed requirement (24590-WTP-RPT-PO-03-007, Ref. 8.1.1(19), Section 9). Maximum weight % suspended solids based on weight % water in the slurry is 64% (24590-LAW-MVC-LFP-00001, Ref. 8.1.4(19), Section 7.4.1). Assuming no dilution (due to flush water or DIW addition) in LFP-VSL-00002/4, the upper bounding solids concentration for stream LFP04 is 64 wt%.

Slurry Density
The density of stream LFP04 will normally range from 97.6 lb/ft^3 to 106 lb/ft^3 (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). The normal slurry density is the average of this range, 101.8 lb/ft^3. LFP-VSL-00002/4 vessel design specific gravity is 1.9 (~119 lb/ft^3) and is considered an extreme maximum (24590-LAW-MVD-LFP-00007, Ref. 8.1.5(11)).

Slurry pH
Slurry pH for stream LFP04 ranges from 13.5 to 14.5 (24590-WTP-DB-PET-09-001, Ref. 8.1.1(5), Table B-17). The nominal pH for this stream will be provided in the corrosion data sheet.

6.2.3.3.2 Off-Spec Melter Feed to LFP-VSL-00001/3 (off-normal)

Off-spec melter feed from LFP-VSL-00002/4 can be returned to LFP-VSL-00001/3. If the melter feed needs to be transferred back to the Pretreatment facility plant wash vessel, PWD-VSL-00044 for reprocessing, further dilution can be performed in the LAW plant wash vessel until the solids content is less than 5 wt% (24590-LAW-3YD-LFP-00001, Ref. 8.1.2(2), Section 6.2.1).

This transfer is considered an off-normal, infrequent event. Therefore, this transfer will not be discussed further in this document.

6.2.3.3.3 Overflow to RLD-VSL-00004 (off-normal)

Overflow to RLD-VSL-00004 would have the same properties as LFP04 but is considered an off-normal, infrequent event. Therefore, this transfer will not be discussed further because it is an off-normal process stream.

6.2.4 Process Modes

6.2.4.1 Normal Operations

Based on the assessment of streams frequently transferred in and out of LFP-VSL-00001/3, One normal processing mode is considered:

1) Receipt of Blended Feed from Melter Feed Prep Vessel

Section 6.1.5.1 summarizes in tabular form each of these processing modes.

6.2.4.2 Infrequent Operations

The LAW Melter Feed Preparation Vessels (LFP-VSL-00002/4) do not have any infrequent modes of operation. All modes of operation either fall within the definition of normal operations or off-normal operations. Off-normal conditions of operation are not included in this document.

6.2.5 Summary of Processing Conditions for LFP-VSL-00002/4

6.2.5.1 Normal Operations

The following table summarizes the normal processing mode for vessels LFP-VSL-00002/4 where the vessels receive blended melter feed from LFP-VSL-00001/3 and mix the feed prior to transfer to the corresponding melter, LMP-MLTR-00001 or LMP-MLTR-00002.

Summary of LFP-VSL-00002/4 Conditions for Processing

Stream Number	Weight % UDS		Na Molarity		Temperature (°F)	
	normal	upper	normal	upper	normal	upper
LFP05	40.5	64.0	4.3	4.8	130	150
LFP04	40.9	64.0	4.4	4.9	137	150

6.2.5.2 Infrequent Operations

None identified.

CORROSION EVALUATION

LOP-SCB-00001 & LOP-SCB-00002
Melter 1 and Melter 2 Submerged Bed Scrubbers (SBS)

Contents of this document are Dangerous Waste Permit affecting

Results

Materials Considered:

Material (UNS No.)	Acceptable Material
Carbon Steel	
Type 304L (S30403)	X (External coils and skirt only)
Type 316L (S31603)	X (External coils and skirt only)
AL-6XN® 6% Mo (N08367)	
Hastelloy® C-22® (N06022)	X
Ti-2 (R50400)	

Recommended Material Type: **Vessel head/shell – Hastelloy® C-22® (N06022)**
Internals, including internal cooling coils – Hastelloy® C-22® (N06022)
Half-pipe coils (external) – Type 304L (max 0.030% C; dual certified)
Support – Type 304L (max 0.030% C; dual certified)
Internal packing is a ceramic

Minimum Corrosion Allowance: **0.040 inch (includes 0.024 inch corrosion allowance and 0.004 inch erosion allowance)**

Inputs and References

- Operating temperature (°F) (min/max): 104/140 (24590-LAW-MVC-LOP-00001)
- Corrosion allowance: 0.024 inch (24590-WTP-M0E-50-00012)
- Erosion allowance: 0.004 inch (24590-WTP-M0C-50-00004 & 24590-WTP-M0E-50-00012)
- Location: Room L-0123/L-0124; process cell (24590-LAW-P1-P01T-00002)
- Operating conditions are as stated in the applicable section of *WTP Process Corrosion Data - Volume 4* (24590-WTP-RPT-PR-04-0001-04)

Assumptions and Supporting Justifications (see Section 19-References)

- Operating conditions presented on the PCDS are conservative with respect to corrosion.[8]
- During normal operations, primary and standby melter offgas is received from the film coolers at 546 °F (560 °F max).[8]
- During normal operations, offgas is transferred to LOP-WESP-00001/2 at 121 to 122 °F.[8]
- During normal operations, condensate is transferred to RLD-VSL-00005 or recycled back to the SBS at 122 °F (nominal; 140 °F max) and pH ranging from 7 to 13.[8]

Operating Restrictions

- To protect against localized corrosion in the vessel and transfer piping, develop procedure to bring the vessel contents within the limits defined for Hastelloy® C-22® in 24590-WTP-RPT-M-11-002, *WTP Materials Localized Corrosion Design Limits*, in the event that chloride concentration exceeds those limits.
- Develop a procedure to control, at a minimum, cleaning, rinsing, and flushing of vessel and internals, as applicable.
- Develop procedure to control lay-up and storage; includes both before plant is operational and inactive periods during plant operation.
- Procedures are to be reviewed and accepted by MET prior to use.

Concurrence J. Dan
Operations

REV	DATE	REASON FOR REVISION	ORIGINATE	CHECK	REVIEW	APPROVE
4	1/8/16	Complete re-write; no rev bars shown New format Incorporate updated PCDS Add AEA notice Update references	Originator By: Debbie Adler - dladler Org Name: MET Placed: Dec 22, 2015, 12:41 pm	Checked By: A. Rangus - arangus Org Name: Bechtel Placed: Dec 29, 2015, 11:44 am	Reviewed No Comments By: Robert Davis - rbdavis Org Name: Bechtel Placed: Jan 07, 2016, 9:39 am RBDavis	TErwin

CORROSION EVALUATION

Revision History

3		Update wear allowance based on 24590-WTP-RPT-M-04-0008	DLAdler	JRDivine	NA	APRangus
2	7/1/04	Incorporate new PCDS Add Section p – Inadvertent Addition of Nitric Acid	DLAdler	JRDivine	NA	APRangus
1	1/27/04	Update quantity Update equipment description Update design temp/pressure Re-format references Remove reference to open issues Append updated MSDS Add DWP note	DLAdler	JRDivine	APR	APRangus
0	1/29/02	Initial Issue	JRDivine	DLAdler	NA	BPosta
REV	**DATE**	**REASON FOR REVISION**	**PREPARER**	**CHECKER**	**MET**	**APPROVER**

This bound document contains a total of 17 sheets.

CORROSION EVALUATION

Corrosion/Erosion Detailed Discussion

Off gas from the film coolers enters a packed bed column enclosed by a submerged bed scrubber (SBS) for cooling. The SBS is a passive device designed for aqueous scrubbing of entrained radioactive particulates and removal of aerosols from melter off gas. As the offgas cools, water vapor condenses and increases the liquid inventory. The liquid overflows into LOP-VSL-00001 or LOP-VSL-00002, thereby maintaining a constant liquid depth in the SBS. A cooling jacket located on the outside of the scrubber vessel maintains the required temperatures.

1 General/Uniform Corrosion Analysis

a Background
General corrosion or uniform corrosion is corrosion that is distributed more-or-less uniformly over the surface of a material without appreciable localization. This leads to relatively uniform thinning on sheet and plate materials and general thinning on one side or the other (or both) for pipe and tubing. It is recognized by a roughening of the surface and by the presence of corrosion products. The mechanism of the attack is an electrochemical process that takes place at the surface of the material. Differences in composition or orientation between small areas on the metal surface create anodes and cathodes that facilitate the corrosion process.

According to 24590-LAW-3YD-LOP-00001, *System Description for the LAW Primary Offgas (LOP) and Secondary Offgas/Vessel Vent (LVP) Systems*, removal provisions have been provided for those components that are expected to require replacement during the life of the facility, such as the internal basket, the packing, and the supporting hardware.

b Component-Specific Discussion
The scrubber is exposed to hot offgas from the melter and acidic condensate at pH less than 1 regularly recycled by the associated SBS condensate vessel at temperatures up to 140 °F. Based on the expected normal operating conditions, the 300 series stainless steels are not suitable. A more corrosion resistant alloy, such as Hastelloy® C-22® or equivalent, is required. The uniform corrosion rate in alloy C-22® is low under these conditions.

c Packing
The dissolution rate of the ceramic components in the proposed environment is unknown. However, data from Clark and Zoitos (1992) suggest Al_2O_3, SiC, and ZrO_2 ceramics will have little reactivity in the proposed solutions.

d External Cooling Coils
The half-pipe external cooling coils circulate chilled water and have no contact with process fluid or offgas. Corrosion of the cooling coils will be controlled by control over the quality of the cooling water system (24590-WTP-3YD-CHW-00001, *System Description for Lab, BOF, LAW, HLW, and BOF-Supplied PTF Chilled Water System (CHW)*. Type 304L or 316L is acceptable for the external cooling coils in contact with chilled water.

2 Pitting Corrosion Analysis

Pitting is localized corrosion of a metal surface that is confined to a point or small area and takes the form of cavities. Chloride is known to cause pitting in acid and neutral solutions. Normally the vessel is to receive condensate at 122 °F (140 °F max) at a pH less than 1. The temperature could rise to about 167°F in the case of loss of cooling coil function. Data from Phull et al (2000) imply that with these conditions, Hastelloy® C-22 or equivalent will be needed as a minimum. The vessel is operated such that conditions do not promote localized corrosion of the pressure boundary materials. The solution in the vessel will not be left stagnant. The condensate is constantly recycled, pulling liquid from the scrubber bottom.

The chemistry and operating conditions in this vessel fall within the limits established for Hastelloy® C-22® in Table 1-4 of *WTP Materials Localized Corrosion Design Limits* report, 24590-WTP-RPT-M-11-002. For convenience, this comparison is documented on page 6 of this corrosion evaluation.

3 Crevice Corrosion Analysis

Crevice corrosion is a form of localized corrosion of a metal or alloy surface at, or immediately adjacent to, an area that is shielded from full exposure to the environment because of close proximity of the metal or alloy to the surface of another material or an adjacent surface of the same metal or alloy. Crevice corrosion is similar to pitting in mechanism. It can, however, be initiated at lower temperatures.

The vessel is also designed with internal cooling coils that are attached with straps or U-bolts to a frame, allowing for easy removal. Additionally, the top head of the vessel disassembles to facilitate replacement of the ceramic packing. A factor in the recommendation to use Hastelloy® C-22® was the recognition that crevices are inherent to the design. Hastelloy® C-22® has a standard critical crevice temperature above boiling in water with 24,300 ppm chloride and Hastelloy® C-22 or equivalent is needed for internal cooling coils, and straps or U-bolts and frame."

The chemistry and operating conditions in this vessel fall within the limits established for Hastelloy® C-22® in Table 1-4 of *WTP Materials Localized Corrosion Design Limits* report; therefore, Hastelloy® C-22®.

4 Stress Corrosion Cracking Analysis

Stress corrosion cracking (SCC) is the cracking of a material produced by the combined action of corrosion and sustained tensile stress (residual or applied). The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, the environment, and also because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even concentrations as low as 10 ppm have been reported to case SCC in ultra-high purity water (boiling water nuclear reactors).

The chemistry and operating conditions in this vessel fall within the limits established for Hastelloy® C-22® in Table 1-4 of *WTP Materials Localized Corrosion Design Limits* report.

5 End Grain Corrosion Analysis

End grain corrosion is preferential corrosion which occurs along the cold working direction of wrought stainless steels that is exposed to highly oxidizing acidic conditions. Such conditions are not present in the pressure boundary design and nozzles; vessels are all butt-weld joints. End grain corrosion is not a concern for the vessel pressure boundary materials.

6 Weld Corrosion Analysis

Providing correct weld procedures are followed, no preferential corrosion of weld beads or heat-affected zones occurs in nitric acid or alkaline based stream. No additional allowance is made for weld bead corrosion.

Corrosion at the welds includes both the weld HAZ and filler metal, and corrosion depends on the base metal chemistry, welding parameters and filler metal chemistry. The normal uniform corrosion is influenced by the microstructural changes to the alloy. The microstructural changes that contribute to corrosion are solidification micro-segregation that transforms to precipitates, grain boundary coarsening, and carbide precipitation at the grain boundaries. These metallurgical conditions are mitigated by project controls placed on welding parameters and filler metal chemistry. The low carbon content in austenitic stainless steels and nickel alloys prevent base metal sensitization during welding. Controls on the cover gas, heat input, and interpass temperature limit the heat tint. Matching filler metal should be selected. Corrosion at welds is not considered a problem in the proposed environment.

7 Microbiologically Influenced Corrosion Analysis

Microbiologically influenced corrosion (MIC) refers to corrosion affected by the presence or activity, or both, of microorganisms. Typically, with the exception of cooling water systems, MIC is not observed in operating systems. The proposed operating conditions are suitable for microbial growth but the system is downstream of the main entry points of microbes.

The chilled water (CHW) system provides water for vessel cooling coils. According to 24590-WTP-3YD-CHW-00001, sampling capability is provided and chemical additions will be used to ensure that water quality is controlled. Therefore, the potential for MIC in the cooling coils is small.

8 Fatigue/Corrosion Fatigue Analysis

Fatigue is the process of progressive localized permanent structural change occurring in a material subjected to fluctuating stresses less than the ultimate tensile strength of the material. Corrosion fatigue is the process wherein a metal fractures prematurely under conditions of simultaneous corrosion and repeated cyclic loading at lower stress levels or fewer cycles than would be required to cause fatigue of that metal in the absence of the corrosive environment.

Corrosion fatigue is a function of the cyclic loading and corrosive conditions. The vessel design is such that fatigue loads adhere to design code limitations.

Based on the anticipated low mechanical and thermal cycling (24590-WTP-MVC-50-00009, *LAW, BOF, and LAB Vessel Cyclic Datasheet Inputs*), it can be stated that conditions which leads to fatigue or corrosion fatigue are not present in this vessel.

9 Vapor Phase Corrosion Analysis

Conditions in the vapor phase and at the vapor/liquid interface can be significantly different than those present in the liquid phase. The corrosion evaluation of the vapor phase portion of the vessel considers the surface will be covered with a water vapor condensate and possibly droplets of splashed waste and rinse solution. The vessel is fitted with wash rings that will be used periodically to wash down the sides and internal supports. The vapor space corrosion rates are less than the immersed surfaces and the transport away from the surface will be less because of the no-flow conditions. As compared to the corrosion in the immersion section, the corrosion rates in the vapor space are much lower.

Head space corrosion caused by aerosols, vapors, and water generally is a secondary concern for most vessels and tanks that are open to the atmosphere largely because corrosion is self-limiting. The SBS (LOP-SCB-00001/2) and condensate receipt vessel (LOP-VSL-00001/2) are constantly in a state of condensation in the head space. In operation at less than 140 °F, the temperatures are not high enough to evaporate the water in the vapor space. The passive film developed on the Hastelloy® C-22® protects the surface from corrosion in the headspace. The aerosols and vapors are continuously pulled from the head space into the LAW primary offgas (LOP) system and downstream to the secondary offgas/vessel vent (LVP) system. The exact chemistry of the condensation depends on the partial pressures of the species in the liquid phase, which are depressed by the presence of salts in solution. As reported by Schutze, Reback and Bender (2014) the corrosion to Hastelloy® C-22® depends on the concentrations of species in solution and on the temperature. At concentrations less than 50,000 ppm (0.05 wt%) and temperatures less than 140 °F, vapor phase corrosion is negligible.

CORROSION EVALUATION

10 Erosion Analysis

Erosion is the progressive loss of material from a solid surface resulting from mechanical interaction between that surface and a fluid, a multi-component fluid, or solid particles carried with the fluid. The concentration of particles, particle size, and particle velocity are key considerations when considering erosion degradation. Based on the low concentrations, small size, and low velocities in the offgas submerged bed scrubber and associated condensate collection vessels, it can be concluded that the erosion losses are bound by the 0.004 erosion allowance.

The carryover of materials into the offgas can occur by two mechanisms; physical entrainment and vapor phase transport (or volatilization). The waste feed into the melter and onto the cold cap results in flashing. Materials can get airborne by physical entrainment in the steam resulting from the pulling effect of the main exhauster. The entrained particulates consist of oxides, spinels, and glass frit. Calloway (2000) characterized the Duratek LAW pilot melter offgas and determined that the undissolved solids are less than 1%. The mean diameter based on the number of particles is reported by Duratek to be 1.4 µm, more than 90% of the carryover particles are removed by the submerged bed scrubber. The alkali salts of chloride and borate and iron oxides volatilized at the waste glass melting temperature are transported via the offgas flow and condense in the quenching liquid. Upon condensation, these semi-volatile salts would either dissolve in the liquid or become submicron-sized aerosols. The semi-volatile salts that remain in the gas stream are removed in downstream components.

Velocities within the vessel are expected to be below 12 ft/s. Erosion allowance of 0.004 inch for Type 304L and 316L stainless steel components with low solids content (< 2 wt%) at velocities up to 12 ft/s is based on 24590-WTP-M0C-50-00004, *Wear Allowance for WTP Waste Slurry Systems*. Since the Hastelloy® C-22® is stronger and harder than the austenitic stainless steels, the erosive wear allowance used for the austenitic stainless steel is conservative when used for Hastelloy® C-22®.

The recommended general erosion wear allowance of 0.004 inch provides sufficient protection for erosion of the vessel shell. The margin in the erosive wear allowances used above is contained in the referenced calculations (24590-WTP-M0C-50-00004 and 24590-WTP-M0E-50-00012).

11 Galling of Moving Surfaces Analysis

Where two metals are moving in contact with each other without lubrication, there is a risk of damage to their surfaces. No moving unlubricated surfaces are present within the vessel; therefore galling is not a concern.

12 Fretting/Wear Analysis

Fretting corrosion refers to corrosion damage caused by a slight oscillatory slip between two surfaces. Similar to galling but at a much smaller movement, the corrosion products and metal debris break off and act as an abrasive between the surfaces, producing a classic three-body wear problem. This damage is induced under load and repeated relative surface motion. Conditions which lead to fretting are not present in this vessel. The vessel's mechanical datasheet (24590-LAW-MKD-LOP-00008) indicates that thermal cycling will be low (240 cycles for the internal bed and 80 cycles for the cooling water supply and return piping). Additionally, Hastelloy® C-22® exhibits superior mechanical properties, which further protects against fretting corrosion. Therefore fretting is not a concern.

13 Galvanic Corrosion Analysis

Galvanic corrosion is accelerated corrosion caused by the potential difference between the two dissimilar metals in an electrolyte. The galvanic current is sufficient to drive corrosion when the potential difference is greater than 200 mV. One material becomes the anode and the other the cathode. Corrosion occurs on the anode material at the interface where the potential gradient is the greatest. Stainless steels coupled with Hastelloy® C-22® do not have the potential difference to drive galvanic corrosion.

The potential difference for any combination of bi-metal couple of austenitic stainless steels, 6% Mo and, the nickel alloys is not sufficient for galvanic currents to overcome the passive protective film. For such alloys, there is negligible potential difference so galvanic corrosion is not a concern. Even if several alloys are used in this vessel, they are sufficiently similar that corrosion potential differences will be small. Therefore, it can be stated that conditions which lead to galvanic corrosion are not present in this vessel.

14 Cavitation Analysis

Cavitation is the formation and rapid collapse of cavities or bubbles of vapor or gas within a liquid resulting from mechanical or hydrodynamic forces. Cavitation is typically associated with pumps and orifice plates; this vessel has neither. Hastelloy® C-22® displays a superior resistance to cavitation, and WTP vessel design limits conditions which lead to cavitation; therefore cavitation is not a concern.

15 Creep Analysis

Creep is time-dependent strain occurring under stress and is described as plastic flow, yielding at stresses less than the yield strength. Creep is only experienced in plants operating at high temperatures. Temperatures much greater than one half the absolute melting temperature of the alloy are necessary for thermally activated creep to become a concern. The vessel operating and design temperatures are too low to lead to creep; therefore creep is not a concern.

16 Inadvertent Nitric Acid Addition

At this time, the design does not provide for the presence of nitric acid reagent in this system. Additionally, at the maximum operating temperature for this vessel, Hastelloy® C-22® alloy is resistant to the acid gas forming aerosols and vapor in concentrations that emanate from the waste glass melter: HCl, HF, HNO_3, H_2SO_4, and combinations of these. Corrosion rates in nitric acid are less than 1 mpy (Haynes International, 2002). Anderko and Sridhar report corrosion rates for a mixture of HNO_3 and HCl at 2.0 and 2.6 wt% respectively is 0.39 mpy at 174 °F; rates for a mixture of HNO_3 and H_2SO_4, at 15.6 and 8.8 wt% respectively is 0.039 mpy at 174 °F. Inadvertent addition of nitric acid is not a concern.

17 Conclusion and Justification

The conclusion of this evaluation is that LOP-SCB-00001 and LOP-SCB-00002 can be fabricated from Hastelloy® C-22® (or equivalent) which is capable of providing 40 years of service. Based on the expected operating conditions, Hastelloy® C-22® is expected to be satisfactorily resistant to uniform and localized corrosion. The recommended corrosion allowance of 0.024 inch and the recommended erosion allowance of 0.004 inch provide sufficient protection against uniform corrosion and erosion of the vessel. A design corrosion allowance of 0.04 inch is recommended such that there is margin provided (0.012 inch). Based on comparison of the process conditions documented in the *WTP Process Corrosion Data* report, documenting the expected chemistry for comparison to 24590-WTP-RPT-M-11-002, *WTP Materials Localized Corrosion Design Limits*. The Hastelloy® C-22® material has been found to be resistant to localized corrosion.

Because the external cooling coils contact only cooling water, either Type 304L or Type 316L is suitable.

18 Margin

The system is designed with a uniform corrosion allowance of 0.04 inch based on the range of inputs, system knowledge, handbooks, literature, and engineering judgment/experience. The service conditions described above result in a predicted loss due to uniform corrosion and erosion of 0.028 inches. The specified minimum corrosion allowance (0.04 inch) exceeds the minimum required corrosion allowance specified in the input calculations; therefore margin is provided. The uniform corrosion design margin for the operating conditions is sufficient to expect a 40 year operating life and is justified in the referenced calculations. No additional localized erosion requirement has been identified for these vessels.

The recommended general erosion wear allowance of 0.004 inch provides sufficient protection for erosion of the vessel shell. The margin in the erosive wear allowances used above is contained in the referenced calculations (24590-WTP-M0C-50-00004 and 24590-WTP-M0E-50-00012).

The maximum operating parameters for these vessels are defined in the PCDS. As shown in the table below, the PCDS calculated pH, chemistry, and temperature are bounded by the materials localized corrosion design limits documented in the WTP Materials Localized Corrosion Design Limits report. The difference between the design limits and the operating maximums (PCDS value) is the localized corrosion design margin and, based on the operating conditions, is sufficient to expect a 40 year operating life. The Submerged Bed Scrubbers, LOP-SCB-00001 & LOP-SCB-00002, are protected from localized corrosion (pitting, crevice, and stress corrosion) by operating within the acceptable range of the design limits. Operational and process restriction will be used to ensure the limits are maintained.

MATERIALS LOCALIZED CORROSION DESIGN LIMITS – Hastelloy® C-22®			
		pH	**Chloride (ppm)**
DESIGN LIMIT		**5 max**	**30,000 max**
LOP-SCB-00001/2 Continuous SBS Condensate Recycle from LOP-SCB-00001/2 (LOP01)		0.72	3677
Inlet Vessels to LOP-SCB-00001/2		**pH**	**Chloride (ppm)**
LOP-VSL-00001/2 SBS Condensate Recycle to LOP-SCB-00001/2 or Transfer to RLD-VSL-00005 (LOP04/LOP05)		0.72	3677

Inlet vessels to LOP-SCB-00001/2 based on 24590-WTP-RPT-PR-04-0001-04, Section 6.5, and Figure 9.

References sources for this table:

1) Design limits - 24590-WTP-RPT-M-11-002, Table 1-4
2) LOP-SCB-00001/2 (LOP01) – 24590-WTP-RPT-PR-04-0001-04, Figure C-7
3) LOP-VSL-00001/2 (LOP04) – 24590-WTP-RPT-PR-04-0001-04, Figure C-10

Note that the limits documented in 24590-WTP-RPT-M-11-002 do not apply to offgas streams.

CORROSION EVALUATION

19 References:

1. 24590-LAW-3YD-LOP-00001, *System Description for the LAW Primary Offgas (LOP) and Secondary Offgas/Vessel Vent (LVP) Systems.*
2. 24590-LAW-MKD-LOP-00008, *Mechanical Datasheet – 24590-LAW-MK-LOP-SCB-00001, 24590-LAW-MK-LOP-SCB-00002 - Melter 1, 2, 3 Submerged Bed Scrubber.*
3. 24590-LAW-MVC-LOP-00001, *Process Data Input For LAW SBS Condensate Vessels and Pumps (LOP-VSL-00001/2 and LOP-PMP-00001/2/4/5) and SBS Water Purge Pumps (LOP-PMP-00003A/B and LOP-PMP-00006A/B).*
4. 24590-LAW-P1-P01T-00002, *LAW Vitrification Building General Arrangement Plan at El. 3 Feet-0 Inches.*
5. 24590-WTP-M0C-50-00004, *Wear Allowances for WTP Waste Slurry Systems with ECCN 24590-WTP-M0E-50-00012.*
6. 24590-WTP-MVC-50-00009, *LAW, BOF, and LAB Vessel Cyclic Datasheet Inputs.*
7. 24590-WTP-RPT-M-11-002, *WTP Materials Localized Corrosion Design Limits.*
8. 24590-WTP-RPT-PR-04-0001-04, *WTP Process Corrosion Data-Volume 4.*
9. Anderko A and Sridhar N, 2015. *Corrosion of Ni-Based Alloys and Stainless Steels in Mixed Acids and Salts – Experimental and Modeling Results,* Paper 5430, NACE International Corrosion 2015, Houston, TX.
10. Calloway TB, 2000. *Characterization of Melter Off Gas Condensate from the Duratek LAW Pilot Melter Off Gas System,* WSRC-TR-2000-00299, Westinghouse Savannah River Company, Aiken, SC.
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CORROSION EVALUATION

PROCESS CORROSION DATA SHEET (extract)

Component(s) (Name/ID #) Submerged Bed Scrubber (LOP-SCB-00001/2)

Facility LAW

In Black Cell? NO

Chemicals	Unit	Stream ID LOP01 AQUEOUS
Cations (ppm)		
Al^{+3} (Aluminum)	ppm	495
Fe^{+3} (Iron)	ppm	573
Hg^{+2} (Mercury)	ppm	0
Pb^{+2} (Lead)	ppm	24
Anions (ppm)		
Cl^- (Chloride)	ppm	3677
CO_3^{-2} (Carbonate)	ppm	0
F^- (Fluoride)	ppm	7625
NO_2^- (Nitrate)	ppm	0
NO_3^- (Nitrite)	ppm	0
PO_4^{-3} (Phosphate)	ppm	32
SO_4^{-2} (Sulfate)	ppm	3021
$OH(aq)^-$	ppm	763
$OH(s)^-$	ppm	0
pH		0.72
Suspended Solids	wt%	0
Temperature	°F	140
Liquid Density*	lb/ft3	not reported

Chemicals	Unit	Stream ID LMP14 GASEOUS
HCl	ppmV	558
HF	ppmV	4357
NH3	ppmV	22
NO	ppmV	2129
NO2	ppmV	10
SO2	ppmV	35
Relative Humidity	%	0.43
Temperature	°F	560

Figure C- 7 LOP-SCB-00001/2 Aqueous PCDS

Vessel : LOP_SCB_1/2

	Stream ID		
	LMP14	LOP04	LOP01
Properties			
Suspended Solids [wt %]	0	0	0
Total Salts [wt %]	0.30	4.70	2.72
Sodium Molarity [M]	8.92E-06	5.68E-01	2.00E-01
Relative Humidity [%]	0.43	n/a	n/a
pH	n/a	0.17	0.72
Anti-Foam Agent [ppm]	6.82E-07	5.37E-07	1.87E-06
TOC [kg/h]	5.21E-03	1.63E-01	5.32E+00
Pressure [bar]	0.97	0.89	0.96
Temperature [C]	293.33	60.00	60.00
Temperature [F]	560.00	140.00	140.00
Water Flow Rate [kg/hr]	516.77	17,674.65	18,032.97
Total Aqueous Flow Rate [kg/hr]	518.35	18545.85	18537.86
Total Flow Rate [kg/hr]	5.18E+02	1.85E+04	1.85E+04
UserNote	VIT VAPOR SBS Inlet Offgas (Primary)	VIT LIQUID SBS Condensate Recycle to SBS	VIT LIQUID SBS Condensate Overflow
AQUEOUS			
Cations (ppm)			
Ag+	0	0	0
Al+3	77	105	495
Am+3	0	0	0
As+5	1	0	0
B+3	291	398	1857
Ba+2	0	0	0
Be+2	0	0	0
Bi+3	0	0	0
Ca+2	52	71	485
Cd+2	0	0	0
Ce+4	5	0	0
Co+2	0	0	0
Cr+3	0	0	0
Cr+6	33	38	145
Cs+	0	0	0
Cu+2	0	0	0
Eu+3	0	0	0
Fe+2	0	0	0
Fe+3	89	121	573
H+	0	662	238
Hg+2	1	0	0
K+	145	160	224
La+3	0	0	0
Li+	97	117	1346
Mg+2	2	2	20
Mn+4	2	0	0
Mo+6	0	0	0
Na+	1815	12797	4587
Nd+3	0	0	0
Ni+2	1	1	10
Pb+2	0	0	24
Pd+2	0	0	0
Pr+4	0	0	0
Pu+4	0	0	0
Ra+2	0	0	0
Rb+	0	0	0
Rh+3	0	0	0
Ru+4	0	0	0
Sb+3	1	0	0
Se+4	3	3	5
Si+4	279	353	950
Sr+2	0	0	0
Ta+5	0	0	0
Tc+4	0	0	0
Te+4	0	0	0
Th+4	0	0	1
Ti+4	31	43	203
Tl+5	2	3	4
U+4	0	0	0
V+3	1	0	0
W+6	0	0	0
Y+3	0	0	0
Zn+2	101	134	629
Zr+4	6	7	35
Anions (ppm)			
B(OH)4-	0	0	0
C2O4-2	0	0	0
Cl-	0	10287	3677
CN-	0	0	0
CO3-2	0	0	0
F-	0	21331	7625
H2PO4-	0	0	0
H2SiO4-2	0	0	0
H3SiO4-	0	0	0
HCO3-	0	0	0
HPO4-2	0	0	0
HSO3-	0	0	0
HSO4-	0	0	0
I-	0	0	0
IO3-	0	0	0
NH4+	0	0	0
NO2-	0	0	0
NO3-	0	0	0
O-2	0	0	0
O2-2	0	0	0
OH(aq)-	0	0	763
OH(s)-	0	0	0
PO4-3	0	4	32
SO3-2	0	0	0
SO4-2	0	328	3021
Organics (ppm)			
AFA_DCMP	0	0	0
AFA_NVOC	0	0	0
NVOC	0	0	0
Sucrose	0	0	0
SVOC	7	9	287
VOC	3	0	0

Figure C- 8 LOP-SCB-00001/2 Gaseous PCDS

Vessel : LOP_SCB_1/2

	Stream ID		
	LMP14	LOP04	LOP01
Properties			
Suspended Solids [wt %]	0	0	0
Total Salts [wt %]	0.30	4.70	2.72
Sodium Molarity [M]	8.92E-06	5.69E-01	2.00E-01
Relative Humidity [%]	0.43	n/a	n/a
pH	n/a	0.17	0.72
Anti-Foam Agent [ppm]	6.82E-07	5.37E-07	1.87E-06
TOC [kg/h]	5.21E-03	1.63E-01	5.32E+00
Pressure [bar]	0.97	0.89	0.90
Temperature [C]	293.33	60.00	60.00
Temperature [F]	560.00	140.00	140.00
Water Flow Rate [kg/hr]	516.77	17,674.65	18,032.97
Total Aqueous Flow Rate [kg/hr]	518.35	18545.85	18537.86
Total Flow Rate [kg/hr]	5.18E+02	1.85E+04	1.85E+04
UserNote	VIT VAPOR SBS Inlet Offgas (Primary)	VIT LIQUID SBS Condensate Recycle to SBS	VIT LIQUID SBS Condensate Overflow
GASEOUS [ppmV or mg/m³]			
Ar	7404	0	0
CH3I	0	0	0
Cl2	0	0	0
CO	421	0	0
CO2	25417	0	0
F2	0	0	0
H2	0	0	0
HCl	558	0	0
HCN	0	0	0
HF	4357	0	0
I2	0	0	0
N2	624526	0	0
NaCl(s)	1591	0	0
NaCN(s)	0	0	0
NaF(s)	675	0	0
NaI(s)	0	0	0
NH3	22	0	0
NO	2129	0	0
NO2	10	0	0
O2	165194	0	0
P2O5(s)	10	0	0
PO2	0	0	0
SO2	35	0	0
SO3(s)	105	0	0

Note: Concentrations for constituents representing particulates (as denoted by suffix "(s)" in their name) are reported in units of mg/m3; all others are reported in units of ppmV

GENERAL NOTE FOR USE OF PCDS:

- *The information provided by the PCDS report is intended solely for use in support of the vessel material selection process and Corrosion Evaluations. The inputs, assumptions, and computational/engineering models used in generating the results presented herein are specific to this effort. Use of the information presented herein for any other purpose will require separate consideration and analysis to support justification of its use for the desired, alternative purpose.*
- *The process descriptions in this report cover routine process operations and non-routine (infrequent) process operations, when such exist, that could impact corrosion or erosion of process equipment.*
- *The data in the non-shaded columns of the PCDSs has NOT been adjusted to comply with the highest expected, vessel-specific operational conditions.*
- *The process descriptions provided in this report are for general information and reflective of the corrosion engineer's analysis for transparency, the information is current only at the time this document is issued. These process descriptions should not be referenced for design.*

CORROSION EVALUATION

6.5 Submerged Bed Scrubber (LOP-SCB-00001/2) and Wet Electrostatic Precipitator (LOP-WESP-00001/2)

6.5.1 Description of Vessel/Equipment

The LAW primary offgas process (LOP) system is designed to treat the offgas so that it conforms to relevant federal, state, and local air emissions requirements at the point of discharge from the facility stack. The principal gas generated by the melter is steam. Decomposition of salts and organic material also yields CO_2, SO_2, NO_x, HCl, and HF. The NO_x is a mixture of NO and NO_2 with trace amounts of N_2O.

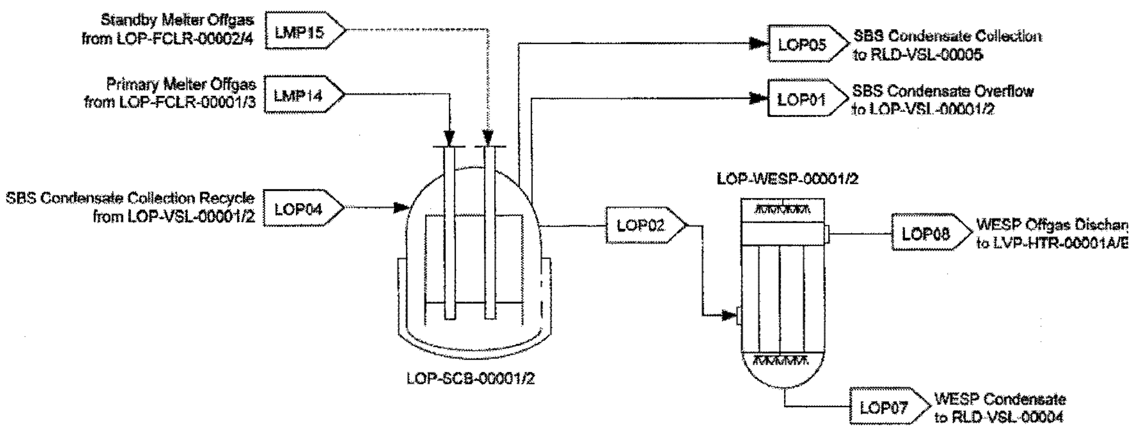
The Submerged Bed Scrubbers (LOP-SCB-00001/2) has two offgas inlet lines, one for normal operations coming from the Primary Film Cooler and one for standby coming from the Standby Film Cooler. The inlet pipes run down through the bed to the packing support plate. The bed-retaining walls extend below the support plate, creating a lower skirt to prevent gas from bypassing the packing. A hold-down screen is used to prevent the bed from being carried out by upward flow through the bed. Gas bubbles are formed as the gas passes through holes in the support plate. The bubbles rise through the packed bed and cause the liquid to circulate up through the packing, and hence downward in the annular space outside the packed bed. The packing breaks larger bubbles into smaller ones to increase the gas-to-water contact area and helps increase the particulate removal and heat transfer efficiencies.

After initial aerosol and soluble gas removal in the SBS, the cooled offgas is routed to a WESP (LOP-WESP-00001/2) for further removal of particulates and aerosols. Each melter system has a dedicated WESP. LOP-WESP-00001 and LOP-WESP-00002 are located in the same rooms of the process cell as the corresponding SBS, at the 3-foot elevation.

Each WESP receives offgas at a nominal flow rate of 1280 scfm at 122°F and -49 in. WG. The offgas enters the unit and passes through a distribution plate. The evenly distributed saturated gas then flows upward through the tubes of the WESP. The tubes act as positive electrodes. Each tube also has a single negatively charged electrode that runs down the center of the tube. A high voltage transformer/rectifier supplies power to these electrodes. A strong electric field is generated along the electrode, supplying a negative charge to aerosols as they pass through the tubes. The negatively charged aerosols move toward the positively charged tube walls where they are removed. The inlet is also provided with a spray to enhance rundown and cleaning. The condensate then drains into a C3/C5 drain/sump collection vessel (RLD-VSL-00004). Each WESP is equipped with a spray wash ring at the top of the unit to perform periodic washdown of the electrodes and vessel walls.

Figure 9 is a sketch of the input and output arrangement of streams for LOP-SCB-00001/2 and LOP-WESP-00001/2. Streams that are not primary routes (infrequent transfers) are represented with dashed lines.

Figure 9 LOP-SCB-00001/2 and LOP-WESP-00001/2 Sketch



6.5.2 System Functions

The process functions of this vessel are as follows:

- Draw Melter Offgas
- Treat Melter Offgas
- Exhaust WESP Offgas
- Transfer Process Liquids

These equipment items perform additional system functions beyond the process functions, but these are outside the scope of this document. The non-process functions are not discussed any further in this document. However, they are listed below for completeness:

- Maintain Negative Pressure
- Maintain Pressure Boundary

6.5.3 Description of Process Functions

6.5.3.1 Draw Melter Offgas

The following process streams are taken from process flow diagram 24590-LAW-M5-V17T-00007/8 (Ref. 7.1.3(15)(16)) and associated drawing change notices (DCNs):

- LMP14 - Draw primary melter offgas from LOP-FCLR-00001/3
- LMP15 - Draw standby melter offgas from LOP-FCLR-00002/4

6.5.3.1.1 LMP14 - Draw primary melter offgas from LOP-FCLR-00001/3

Stream LMP14 is the primary offgas stream from LOP-FCLR-00001/3, sent to the submerged bed scrubber, LOP-SCB-00001/2.

Molarity
Stream LMP14 is an offgas stream, therefore sodium concentration is not applicable (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)).

Temperature
The nominal temperature of stream LMP14 ranges from 533°F to 560°F (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)). The normal temperature is the average of this range, 546.5°F.

Solids Concentration
Stream LMP14 is an offgas and solids concentration is not applicable (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)).

Vapor Density
The minimum and maximum vapor density of stream LMP14 is 3.3×10^{-2} lb/ft^3 to 3.4×10^{-2} lb/ft^3, respectively (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)). The normal vapor density is the average of this range, 3.35×10^{-2} lb/ft^3.

pH
Stream LMP14 is an offgas stream, therefore pH is not applicable (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)).

6.5.3.1.2 LMP15 - Draw standby melter offgas from LOP-FCLR-00002/4

Stream LMP15 is the standby offgas stream from LOP-FCLR-00002/4 to the submerged bed scrubber, LOP-SCB-00001/2. It is not used in normal operation and is considered off normal. Physical properties of this stream are represented by stream LMP14 but will not be discussed further in this document.

6.5.3.2 Treat Melter Offgas

The following process stream is taken from process flow diagram 24590-LAW-M5-V17T-00007/8 (Ref. 7.1.3(15)(16)) and associated DCNs:

- LOP02 - Transfer melter offgas from LOP-SCB-00001/2 to LOP-WESP-00001/2

6.5.3.2.1 LOP02 - Transfer melter offgas from LOP-SCB-00001/2 to LOP-WESP-00001/2

Stream LOP02 is the submerged bed scrubber, LOP-SCB-00001/2, offgas discharge to the wet electrostatic precipitator, LOP-WESP-00001/2.

Molarity
Stream LOP02 is an offgas stream, therefore sodium concentration is not applicable (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)).

Temperature
The nominal temperature of stream LOP02 ranges from 121°F to 122°F (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)). The normal temperature is the average of this range, 121.5°F.

Solids Concentration
Stream LOP02 is an offgas stream, therefore solids concentration is not applicable (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)).

Vapor Density
The minimum and maximum vapor density of stream LOP02 is 6.2×10^{-2} lb/ft^3 to 6.3×10^{-2} lb/ft^3, respectively (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)). The normal vapor density is the average of this range, 6.25×10^{-2} lb/ft^3.

pH
Stream LOP02 is an offgas stream, therefore pH is not applicable (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)).

6.5.3.3 Exhaust Melter Offgas

The following process stream, taken from process flow diagram 24590-LAW-M5-V17T-00007/8 (Ref. 7.1.3(15)(16)) and associated DCNs, is the output from LOP-WESP-00001/2:

- LOP08 - WESP offgas discharge to LVP-HTR-00001A/B

6.5.3.3.1 LOP08 - WESP offgas discharge to LVP-HTR-00001A/B

Stream LOP08 is the WESP, LOP-WESP-00001/2, offgas discharge to secondary treatment, LVP-HTR-00001A/B.

Molarity
Stream LOP08 is an offgas and sodium concentration is not applicable (24590-WTP-DB-PET-09-001, Table B-20, Ref. 7.1.1(3)).

Temperature
The nominal temperature of stream LOP08 ranges from 121°F to 126°F (24590-WTP-DB-PET-09-001, Table B-20, Ref. 7.1.1(3)). The normal temperature is the average of this range, 123.5°F.

Solids Concentration
Stream LOP08 is an offgas and solids concentration is not applicable (24590-WTP-DB-PET-09-001, Table B-20, Ref. 7.1.1(3)).

CORROSION EVALUATION

Vapor Density
The minimum and maximum vapor density of stream LOP08 is 6.2×10^{-2} lb/ft^3 to 6.3×10^{-2} lb/ft^3, respectively (24590-LAW-MVC-LOP-00001, Section 7.6.2, Ref. 7.1.4(21)). The normal vapor density is the average of this range, 6.25×10^{-2} lb/ft^3.

pH
Stream LOP08 is an offgas and pH is not applicable (24590-WTP-DB-PET-09-001, Table B-20, Ref. 7.1.1(3)).

6.5.3.4 Transfer Process Liquid

The following process streams, taken from Process Flow Diagram 24590-LAW-M5-V17T-00007/8 (Ref. 7.1.3(15)(16)) and associated DCNs, are inputs/outputs from LOP-SCB-00001/2 and LOP-WESP-00001/2:

- LOP05 - Transfer SBS condensate to RLD-VSL-00005
- LOP04 - Recycle SBS condensate to LOP-SCB-00001/2
- LOP01 - Continuous overflow of LOP-SCB-00001/2 to LOP-VSL-00001/2
- LOP07 - WESP condensate to RLD-VSL-00004

6.5.3.4.1 LOP05 - Transfer SBS condensate to RLD-VSL-00005

Stream LOP05 is the submerged bed scrubber, LOP-SCB-00001, condensate purge to RLD-VSL-00005.

Molarity
The sodium concentration of LOP05 may range from 0.1 to 0.2 M (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)). The nominal sodium concentration is the average of this range, 0.15 M and the upper sodium concentration for stream LOP05 is 0.2 M.

Temperature
The nominal temperature of stream LOP05 ranges from 121 to 122°F (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)). The minimum temperature is 104°F and the maximum is 140°F (24590-LAW-MVC-LOP-00001, Section 6.1, Ref. 7.1.4(21)). Therefore, 122°F is considered nominal temperature and 140°F is considered upper highest expected temperature for stream LOP05.

Solids Concentration
The solids will range from 0.2 to 0.3 wt% UDS (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)). The nominal solids concentration for stream LOP05 is the average of this range, 0.25 wt% UDS.

Slurry Density
The minimum and maximum density of stream LOP05 is 62.2 lb/ft^3 to 62.8 lb/ft^3, respectively (24590-LAW-MVC-LOP-00001, Section 7.6.2, Ref. 7.1.4(21)). The normal slurry density is the average of this range, 62.5 lb/ft^3.

Slurry pH
Slurry pH for stream LOP05 ranges from 7 to 13 (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)). The resulting pH for this stream will be provided in the corrosion data sheet.

CORROSION EVALUATION

6.5.3.4.2 LOP04 - Recycle SBS condensate to LOP-SCB-00001/2

Stream LOP04 is the recycle of SBS condensate back to LOP-SCB-00001/2 and has the same properties as LOP05.

6.5.3.4.3 LOP01 - Continuous overflow of LOP-SCB-00001/2 to LOP-VSL-00001/2

Stream LOP01 is the continuous overflow of LOP-SCB-00001/2 to LOP-VSL-00001/2 and has the same properties as LOP05.

6.5.3.4.4 LOP07 - WESP condensate to RLD-VSL-00004

Stream LOP07 is the WESP condensate drainage from the Wet Electrostatic Precipitators (LOP-WESP-00001/2) to RLD-VSL-00004. The C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004) collects a constant liquid stream drained from the Wet Electrostatic Precipitators (LOP-WESP-00001/2).

Molarity
Since there is no chemical adjustment of the liquid stream drained from the Wet Electrostatic Precipitators (LOP-WESP-00001/2) prior to being collected in the C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004), the sodium molarity is not a controlled parameter for the process stream LOP07. However, the upper concentration of sodium is 0.2 molar Na, as determined by the Process Inputs Basis of Design (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)).

Temperature
Heat losses in the piping between the WESPs and RLD-VSL-00004 are assumed to be negligible due to the short piping distance and the high transfer rate. Mist condensate is assumed to enter RLD-VSL-00004 at the same temperature at which it exited the WESPs. Mist condensate is assumed to exit the WESPs at a nominal 121°F, which is the same temperature as the offgas entering the WESP from the Submerged Bed Scrubber (24590-LAW-MVC-RLD-00009, Ref. 7.1.4(24), Section 6.1.3). Therefore, the nominal temperature of stream LOP07 is 121°F. The maximum temperature of the WESP off-gas discharge is 126°F (24590-LAW-MEC-RLD-00001, Ref. 7.1.4(18), Section 2.16).

Solids Concentration
The drainage from the WESPs is essentially water and process stream LOP07 is expected to have the same physical properties as water (24590-LAW-MVC-RLD-00009, Ref. 7.1.4(24), Section 6.1.5). The normal concentration of suspended solids for process stream LOP07 is approximately 0 wt% or negligible UDS (24590-WTP-DB-PET-09-001, Ref. 7.1.1(3), Appendix B, Table B-20).

Liquid Density
The minimum, nominal, and maximum densities for stream LOP07 are 61.0 lb/ft^3, 61.7 lb/ft^3, and 62.4 lb/ft^3 respectively (24590-LAW-MVC-RLD-00009, Ref. 7.1.4(24), Section 7.5.2).

Liquid pH
Liquid pH of stream LOP07 will normally range from 1.0-11.0 (24590-WTP-DB-PET-09-001, Ref. 7.1.1(3), Appendix B, Table B-20). The resulting pH for this stream will be provided in the corrosion data sheet.

6.5.4 Process Modes

6.5.4.1 Normal Operations

Based on the assessment of streams frequently transferred in and out of LOP-SCB-00001/2 and LOP-WESP-00001/2, five normal processing modes are considered:

1) Receipt of melter offgas from LOP-FCLR-00001/3
2) Recycle of SBS condensate back to LOP-SCB-00001/2
3) Transfer of melter offgas to LOP-WESP-00001/2
4) Transfer of SBS condensate to RLD-VSL-00004/5
5) Exhaust of melter offgas to LVP-HTR-00001A/B

Section 6.5.5.1 summarizes in tabular form each of these processing modes.

6.5.4.2 Infrequent Operations

There are no infrequent operations identified for LOP-SCB-00001/2 and LOP-WESP-00001/2.

6.5.5 Summary of Processing Conditions for LOP-SCB-00001/2 and LOP-WESP-00001/2

6.5.5.1 Normal Operations

The following table summarizes the normal processing streams for LOP-SCB-00001/2 and LOP-WESP-00001/2 where melter offgas is treated then exhausted.

Summary of LOP-SCB-00001/2 and LOP-WESP-00001/2 Normal Conditions for Processing

Stream Number	Weight % UDS		Na Molarity		Temperature (°F)	
	normal	upper	normal	upper	normal	upper
LMP14	n/a	n/a	n/a	n/a	546.5	560
LOP02	n/a	n/a	n/a	n/a	121.5	122
LOP01	0.25	0.3	0.15	0.2	122	140
LOP04	0.25	0.3	0.15	0.2	122	140
LOP05	0.25	0.3	0.15	0.2	122	140
LOP07	0	0	0.1	0.2	121	126
LOP08	n/a	n/a	n/a	n/a	123.5	126

6.5.5.2 Infrequent Operations

None identified.

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RPP-WTP PDC

CORROSION EVALUATION

LOP-VSL-00001 & LOP-VSL-00002
Melter 1 & Melter 2 SBS Condensate Vessel

Appurtenances
LOP-EDUC-00001 and LOP-EDUC-00002

Contents of this document are Dangerous Waste Permit affecting

Results

Materials Considered:

Material (UNS No.)	Acceptable Material
Carbon Steel	
Type 304L (S30403)	X (cooling jacket only)
Type 316L (S31603)	X (cooling jacket only)
Grade CF8M (J92900)	X (eductors only)
AL-6XN® 6% Mo (N08367)	
Hastelloy® C-22® (N06022)	X
Hastelloy® C-276 (N10267)	X
Ti-2 (R50400)	

Recommended Material Types:
Vessel head & shell– UNS N06022
Internals – UNS N06022 or UNS N10267
Eductors/Spray Nozzles – CF8M or Type 316 (not welded)
Cooling jacket – Type 304 (max 0.030% C; dual certified)

Minimum Corrosion Allowance: **0.040 inch (includes 0.024 inch corrosion allowance and 0.004 erosion allowance)**

Replaceable Subcomponents:
Eductors – CF8M
Gamma Jet Spray Nozzles – Type 316

40-year design life is not applicable. The material that has been selected for these components has corrosion resistance sufficient to expect a period of operation in excess of multiple inspection cycles.

Inputs and References
- Operating Temperature (°F) (norm/max): 122/140 (24590-LAW-MVC-LOP-00001)
- General corrosion allowance (inch): 0.024 (24590-WTP-M0E-50-00023)
- General erosion allowance (inch): 0.004 (24590-WTP-M0E-50-00023)
- Location: Rooms L-0123/0124 (24590-LAW-P1-P01T-00002)
- Operating conditions are as stated in the applicable section of *WTP Process Corrosion Data - Volume 4* (24590-WTP-RPT-PR-04-0001-04)

Assumptions and Supporting Justifications (see References, Section 19)
- Operating conditions presented on the PCDS are conservative with respect to corrosion.[7]
- During normal operations, SBS condensate continuous overflow is received from LOP-SCB-00001/2 at 122 °F (140 °F max) and pH below 1; SBS condensate is also recycled to the LOP-SCB-00001/2.[7]
- During normal operations, SBS condensate is transferred to RLD-VSL-00005.[7]
- Vessels have cooling jackets, which will maintain condensate temperature.
- Purge pumps LOP-PMP-00001/2/4/5 are incorrectly shown on Figure 8, LOP-VSL-00001/2 Sketch, as ADS pumps. These pumps are vertical cantilever type.

Operating Restrictions
- To protect against localized corrosion in the vessel and transfer piping, develop procedure to bring the vessel contents within the limits defined for Hastelloy® C-22® in Table 18-1 of 24590-WTP-DB-ENG-01-001, *Basis of Design*, in the event that chloride concentration exceeds those limits.
- Develop a procedure to control, at a minimum, cleaning, rinsing, and flushing of vessel and internals, as applicable.
- Develop procedure to control lay-up and storage; includes both before plant is operational and inactive periods during plant operation.
- Procedures are to be reviewed and accepted by MET prior to use.

Concurrence KG
Operations

6	11/18/18	Update references Note regarding pumps in Figure 8	Originator By: Debbie Adler - dadler Org Name: MET Placed: Nov 08, 2018	Checked By: - mfang Org Name: Placed: Nov 08, 2018	Reviewed No Comments By Dr Robert Davis - rbdavis Org Name: Bechtel Placed: Nov 09, 2018 RBDavis	JLJulyk
REV	**DATE**	**REASON FOR REVISION**	**ORIGINATE**	**CHECK**	**REVIEW**	**APPROVE**

CORROSION EVALUATION

REVISION HISTORY

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	MET	APPROVER
5	4/11/17	Clarification of replaceable subcomponents Location-Eliminate reference to Wet Process Cells	DLAdler	TRangus	RBDavis	TErwin
4	7/28/15	Complete re-write; no rev bars shown New format Identified internal components Incorporate revised PCDS Add AEA notice Update references	DLAdler	TRangus	RBDavis	TErwin
3	5/24/05	Update wear allowance based on 24590-WTP-RPT-M-04-0008	DLAdler	JRDivine	NA	APRangus
2	6/2/04	Incorporate new PCDS Add Section p – Inadvertent Addition of Nitric Acid	DLAdler	JRDivine	NA	APRangus
1	1/27/04	Update vessel design info Update format Remove reference to open issues Add DWP note	DLAdler	JRDivine	APR	APRangus
0	1/24/02	Initial Issue	JRDivine	DLAdler	NA	BPosta

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 13 sheets.

CORROSION EVALUATION

Corrosion/Erosion Detailed Discussion

The SBS receives offgas from the melter film cooler with the purpose of removing carryover particulate solids and acid gas forming molecules, condensing the vapor, and cooling the offgas stream. For interim storage capacity of the condensed fluids, the SBS overflows to the SBS condensate vessels (LOP-VSL-00001/2). The SBS condensate vessels are used as buffer containers for the accumulating SBS condensate fluids while recycling the condensate fluids back to the SBS, facilitating the cooling of the columns and maintaining the column liquid level. The SBS condensate vessels have liquid-liquid eductors that are motivated by the recirculation pump system to sustain the recycle of condensate. The SBS condensate vessels are connected to the offgas system and are operated under partial vacuum.

1 General/Uniform Corrosion Analysis

a Background

General corrosion or uniform corrosion is corrosion that is distributed more-or-less uniformly over the surface of a material without appreciable localization. This leads to relatively uniform thinning on sheet and plate materials and general thinning on one side or the other (or both) for pipe and tubing. It is recognized by a roughening of the surface and by the presence of corrosion products. The mechanism of the attack is an electrochemical process that takes place at the surface of the material. Differences in composition or orientation between small areas on the metal surface create anodes and cathodes that facilitate the corrosion process.

b Component-Specific Discussion

The vessel is exposed to acidic condensate overflow from LOP-SCB-00001/2, which is regularly recycled back to the scrubber. Based on the expected normal operating conditions, an alloy more corrosion resistant than the 300 series stainless steels, such as Hastelloy® C-22® or equivalent, will be required. The uniform corrosion rate for Hastelloy® C-22® is low under these conditions. For this material, 0.024 inch is bounding (24590-WTP-M0E-50-00023, *Removal Of PJM Localized Erosion Allowances And Piping Erosion And Corrosion Allowances From 24590-WTP-M0C-50-00004, Rev. E*).

c Cooling Jacket

The cooling jacket is not in contact with process fluid but rather only chilled water. Corrosion of the cooling jacket will be controlled by control over the quality of the cooling water system (24590-WTP-3YD-CHW-00001, *System Description for the WTP Chilled Water System (CHW)*. The reported operating conditions of the waste suggest that Hastelloy® C-22® is required for the vessel; however, either Type 304L or 316L is acceptable for the cooling jacket.

d Eductors/Spray Nozzles

Eductors and spray nozzles are subcomponents inside the vessel (LOP-VSL-00001/2) that can be replaced if visual inspection shows that the component has degraded. As such, the requirement for a 40-year design life does not apply. These subcomponents are expected to be included in the Reliability Centered Maintenance program (24590-WTP-PD-RAEN-EN-0004, *Reliability Centered Maintenance (RCM) Program Description*, and 24590-WTP-GPP-RAEN-EN-0024, *Reliability Centered Maintenance Condition Based Monitoring).* Type 316 or Type 316L austenitic stainless steel is the standard commercial off-the-shelf (COTS) material for the eductors and spray nozzles.

2 Pitting Corrosion Analysis

Pitting is localized corrosion of a metal surface that is confined to a point or small area and takes the form of cavities. Chloride is known to cause pitting in acid and neutral solutions. Normally the vessel is to operate at 122 °F (140 °F max) at a bounding pH less than 1. The vessel is operated such that conditions do not promote localized corrosion. The vessel contents are not stagnant. The condensate overflow received is recirculated to the LOP-SCB-00001/2 as necessary; the contents are pumped out about every 2 days

The chemistry and operating conditions in this vessel fall within the limits established for Hastelloy® C-22® in Table 18-1 of *Basis of Design*, 24590-WTP-DB-ENG-01-001.

3 Crevice Corrosion Analysis

Crevice corrosion is a form of localized corrosion of a metal or alloy surface at, or immediately adjacent to, an area that is shielded from full exposure to the environment because of close proximity of the metal or alloy to the surface of another material or an adjacent surface of the same metal or alloy. Crevice corrosion is similar to pitting in mechanism. It can, however, be initiated at lower temperatures.

Crevices in this vessel are limited by the design and fabrication practice. All welding uses butt welds, and crevices are limited to spray nozzle hangers and other internals.

The chemistry and operating conditions in this vessel fall within the limits established for Hastelloy® C-22® in Table 18-1 of *Basis of Design* .

CORROSION EVALUATION

4 Stress Corrosion Cracking Analysis

Stress corrosion cracking (SCC) is the cracking of a material produced by the combined action of corrosion and sustained tensile stress (residual or applied). The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, the environment, and also because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even concentrations as low as 10 ppm can lead to cracking under some conditions.

The chemistry and operating conditions in this vessel fall within the limits established for Hastelloy® C-22® in Table 18-1 of *Basis of Design*.

5 End Grain Corrosion Analysis

End grain corrosion is preferential corrosion which occurs along the cold working direction of wrought stainless steels that is exposed to highly oxidizing acidic conditions. Such conditions are not present in the pressure boundary design; vessels are all butt-weld joints.

Conditions that lead to end grain corrosion are not present in this system.

6 Weld Corrosion Analysis

Providing correct weld procedures are followed, no preferential corrosion of weld beads or heat-affected zones occurs in nitric acid or alkaline based stream. No additional allowance is made for weld bead corrosion.

Corrosion at the welds includes both the weld HAZ and filler metal, and corrosion depends on the base metal chemistry, welding parameters and filler metal chemistry. The normal uniform corrosion is influenced by the microstructural changes to the alloy. The microstructural changes that contribute to corrosion are solidification micro-segregation that transforms to precipitates, grain boundary coarsening, and carbide precipitation at the grain boundaries. These metallurgical conditions are mitigated by project controls placed on welding parameters and filler metal chemistry. The low carbon content in austenitic stainless steels and nickel alloys prevent base metal sensitization during welding. Controls on the cover gas, heat input, and interpass temperature limit the heat tint. Matching filler metal should be selected. Corrosion at welds is not considered a problem in the proposed environment.

7 Microbiologically Influenced Corrosion Analysis

Microbiologically influenced corrosion (MIC) refers to corrosion affected by the presence or activity, or both, of microorganisms.

a Vessel
Typically, with the exception of cooling water systems, MIC is not observed in operating systems. The proposed operating conditions are suitable for microbial growth but the system is downstream of the main entry points of microbes.

b Cooling Jacket
The chilled water (CHW) system provides water for vessel cooling jackets. According to 24590-WTP-3YD-CHW-00001, sampling capability is provided and chemical additions will be used to ensure that water quality is controlled. Therefore, the potential for MIC in the cooling jackets is small.

8 Fatigue/Corrosion Fatigue Analysis

Fatigue is the process of progressive localized permanent structural change occurring in a material subjected to fluctuating stresses less than the ultimate tensile strength of the material. Corrosion fatigue is the process wherein a metal fractures prematurely under conditions of simultaneous corrosion and repeated cyclic loading at lower stress levels or fewer cycles than would be required to cause fatigue of that metal in the absence of the corrosive environment.

Corrosion fatigue is a function of the cyclic loading and corrosive conditions. The vessel design is such that fatigue loads adhere to design code limitations.

Based on the anticipated low mechanical and thermal cycling, it can be stated that conditions with leads to fatigue or corrosion fatigue are not present in this vessel.

9 Vapor Phase Corrosion Analysis

Conditions in the vapor phase and at the vapor/liquid interface can be significantly different than those present in the liquid phase. The corrosion evaluation of the vapor phase portion of the vessel considers the surface will be covered with a water vapor condensate and possibly droplets of splashed waste and rinse solution. The vessel is fitted with wash rings that will be used periodically to wash down the sides and internal supports. The vapor space corrosion rates are less than the immersed surfaces and the transport away from the surface will be less because of the no-flow conditions. As compared to the corrosion in the immersion section, the corrosion rates in the vapor space are much lower.

Vapor phase corrosion is not a concern because the selected high-nickel alloy is resistant to the conditions.

CORROSION EVALUATION

10 Erosion Analysis

Erosion is the progressive loss of material from a solid surface resulting from mechanical interaction between that surface and a fluid, a multi-component fluid, or solid particles carried with the fluid. The concentration of particles, particle size, and particle velocity are key considerations when considering erosion degradation. Based on the low concentrations, small size, and low velocities in the offgas submerged bed scrubber and associated condensate collection vessels, it can be concluded that the erosion losses are bound by the 0.004 erosion allowance.

The carryover of materials into the offgas can occur by two mechanisms; physical entrainment and vapor phase transport (or volatilization). The waste feed into the melter and onto the cold cap results in flashing. Materials can get airborne by physical entrainment in the steam resulting from the pulling effect of the main exhauster. The entrained particulates consist of oxides, spinels, and glass frit. Calloway (2000) characterized the Duratek LAW pilot melter offgas and determined that the undissolved solids are less than 1%. The mean diameter based on the number of particles is reported by Duratek to be 1.4 µm, more than 90% of the carryover particles are removed by the submerged bed scrubber. The alkali salts of chloride and borate and iron oxides volatilized at the waste glass melting temperature are transported via the offgas flow and condense in the quenching liquid. Upon condensation, these semi-volatile salts would either dissolve in the liquid or become submicron-sized aerosols. The semi-volatile salts that remain in the gas stream are removed in downstream components.

Velocities within the vessel are expected to be low. Erosion allowance of 0.004 inch for Type 304L and 316L stainless steel components with low solids content (< 2 wt%) at low velocities is based on 24590-WTP-M0C-50-00004, *Wear Allowance for WTP Waste Slurry Systems*. Since the Hastelloy® C-22® is stronger and harder than the austenitic stainless steels, the erosive wear allowance used for the austenitic stainless steel is conservative when used for Hastelloy® C-22®.

The recommended general erosion wear allowance provides sufficient protection for erosion of the vessel shell. The margin in the erosive wear allowances used above is contained in the referenced calculations (24590-WTP-M0C-50-00004 and 24590-WTP-M0E-50-00023).

11 Galling of Moving Surfaces Analysis

Where two metals are moving in contact with each other without lubrication, there is a risk of damage to their surfaces. No moving unlubricated surfaces are present within the vessel; therefore, galling is not a concern.

12 Fretting/Wear Analysis

Fretting corrosion refers to corrosion damage caused by a slight oscillatory slip between two surfaces. Similar to galling but at a much smaller movement, the corrosion products and metal debris break off and act as an abrasive between the surfaces, producing a classic three-body wear problem. This damage is induced under load and repeated relative surface motion. Conditions which lead to fretting are not present in this vessel; therefore, fretting is not a concern.

13 Galvanic Corrosion Analysis

Galvanic corrosion is accelerated corrosion caused by the potential difference between the two dissimilar metals in an electrolyte. The galvanic current is sufficient to drive corrosion when the potential difference is greater than 200 mV. One material becomes the anode and the other the cathode. Corrosion occurs on the anode material at the interface where the potential gradient is the greatest.

The potential difference for any combination of bi-metal couple of austenitic stainless steels, 6% Mo and, the nickel alloys is not sufficient for galvanic currents to overcome the passive protective film. For such alloys, there is negligible potential difference so galvanic corrosion is not a concern. Even if several alloys are used in this vessel, they are sufficiently similar that corrosion potential differences will be small. Therefore, it can be stated that conditions which lead to galvanic corrosion are not present in this vessel.

14 Cavitation Analysis

Cavitation is the formation and rapid collapse of cavities or bubbles of vapor or gas within a liquid resulting from mechanical or hydrodynamic forces. Cavitation is typically associated with pumps and orifice plates; this vessel has neither. Therefore, damage from cavitation is not expected.

WTP design limits conditions which lead to cavitation; therefore, cavitation is not a concern.

15 Creep Analysis

Creep is time-dependent strain occurring under stress and is described as plastic flow, yielding at stresses less than the yield strength. Creep is only experienced in plants operating at high temperatures. Temperatures much greater than one half the absolute melting temperature of the alloy are necessary for thermally activated creep to become a concern. The vessel operating and design temperatures are too low to lead to creep; therefore, creep is not a concern.

CORROSION EVALUATION

16 Inadvertent Nitric Acid Addition

At this time, the design does not provide for the presence of nitric acid reagent in this system. Additionally, at the maximum operating temperature for this vessel, Hastelloy® C-22® alloy is resistant to the acid gas forming aerosols and vapors in concentrations that emanate from the waste glass melter: HCl, HF, HNO_3, H_2SO_4, and combinations of these. Corrosion rates in nitric acid are less than 1 mpy (Haynes International, 2002). Anderko and Sridhar report corrosion rates for a mixture of HNO_3 and HCl at 2.0 and 2.6 wt% respectively is 0.39 mpy at 174 °F; rates for a mixture of HNO_3 and H_2SO_4, at 15.6 and 8.8 wt% respectively is 0.039 mpy at 174 °F. Inadvertent addition of nitric acid is not a concern.

17 Conclusion and Justification

The conclusion of this evaluation is that LOP-VSL-00001 and LOP-VSL-00002 can be fabricated from Hastelloy® C-22® (or equivalent) which is capable of providing 40 years of service. Based on the expected operating conditions, Hastelloy® C-22® is expected to be satisfactorily resistant to uniform and localized corrosion. The corrosion allowance recommended is 0.024 inch and the recommended erosion allowance of 0.004 inch provides sufficient protection for erosion of the vessel. A general corrosion allowance of 0.04 inch is recommended such that there is margin provided. Based on comparison of the process conditions documented in the *WTP Process Corrosion Data* report, documenting the expected chemistry for comparison to 24590-WTP-DB-ENG-01-001, *Basis of Design*. By observation, the expected chemistry falls well within the applicable limits. The Hastelloy® C-22® material has been found to be resistant to localized corrosion.

Eductors and spray nozzles are subcomponents inside the vessel that can be replaced. As such, the requirement for a 40-year design life does not apply. These subcomponents are expected to be included in the Reliability Centered Maintenance program. The standard material for the eductors and spray nozzles, Type 316 or Type 316L austenitic stainless steel, is acceptable under these circumstances.

18 Margin

The system is designed with a uniform corrosion allowance of 0.04 inch based on the range of inputs, system knowledge, handbooks, literature, and engineering judgment/experience. The service conditions described above result in a predicted loss due to uniform corrosion and erosion of 0.028 inches. The specified minimum corrosion allowance (0.04 inch) exceeds the minimum required corrosion allowance specified in the input calculations; therefore, margin is provided. The uniform corrosion design margin for the operating conditions is sufficient to expect a 40 year operating life and is justified in the referenced calculations. No additional localized erosion requirement has been identified for these vessels.

The maximum operating parameters for this vessel are defined in the PCDS. As shown in the table below, the PCDS calculated pH, chemistry, and temperature are bounded by the materials localized corrosion design limits documented in the WTP Materials Localized Corrosion Design Limits, Table 18-1 of the *Basis of Design*. The difference between the design limits and the operating maximums (PCDS value) is the localized corrosion design margin and, based on the operating conditions, is sufficient to expect a 40 year operating life. The SBS Condensate Vessels, LOP-VSL-00001 and LOP-VSL-00002, are protected from localized corrosion (pitting, crevice, and stress corrosion) by operating within the acceptable range of the design limits. Operational and process restriction will be used to ensure the limits are maintained.

MATERIALS LOCALIZED CORROSION DESIGN LIMITS – Hastelloy® C-22®			
		pH	**Chloride (ppm)**
DESIGN LIMIT		**5 max**	**30,000 max**
LOP-VSL-00001/2 SBS Condensate Recycle to LOP-SCB-00001/2 or Transfer to RLD-VSL-00005 (LOP04/LOP05)		0.72	3677
Inlet Vessels to LOP-VSL-00001/2		**pH**	**Chloride (ppm)**
Continuous SBS Condensate Recycle from LOP-SCB-00001/2 (LOP01)		0.72	3677

Inlet vessels to LOP-VSL-00001/2 based on 24590-WTP-RPT-PR-04-0001-04, Section 6.4, and Figure 8.

References sources for this table:

1) Design limits - 24590-WTP-DB-ENG-01-001, Table 18-1
2) LOP-VSL-00001/2 (LOP04) – 24590-WTP-RPT-PR-04-0001-04, Figure C-10
3) LOP-SCB-00001/2 (LOP01) – 24590-WTP-RPT-PR-04-0001-04, Figure C-7

CORROSION EVALUATION

19 References

1. 24590-LAW-MVC-LOP-00001, *Process Data Input for LAW SBS Condensate Vessels and Pumps (LOP-VSL-00001/2 AND LOP-PMP-00001/2/4/5) and SBS Water Purge Pumps (LOP-PMP-00003A/B AND LOP-PMP-00006A/B).*
2. 24590-LAW-P1-P01T-00002, *LAW Vitrification Building General Arrangement Plan at El. 3 Feet-0 Inches.*
3. 24590-WTP-GPP-RAEN-EN-0024, *Reliability Centered Maintenance Condition Based Monitoring.*
4. 24590-WTP-M0C-50-00004, *Wear Allowance for WTP Waste Slurry Systems with ECCN 24590-WTP-M0E-50-00012*.
5. 24590-WTP-PD-RAEN-EN-0004, *Reliability Centered Maintenance (RCM) Program Description*.
6. 24590-WTP-RPT-M-11-002, *WTP Vessel Localized Corrosion Limit Analysis Report*.
7. 24590-WTP-RPT-PR-04-0001-04, *WTP Process Corrosion Data – Volume 4*.
8. 24590-WTP-3YD-CHW-00001, *System Description for the WTP Chilled Water System (CHW)*.
9. 24590-WTP-DB-ENG-01-001, *Basis of Design*.
10. Anderko A and Sridhar N, 2015. *Corrosion of Ni-Based Alloys and Stainless Steels in Mixed Acids and Salts – Experimental and Modeling Results*, Paper 5430, NACE International Corrosion 2015, Houston, TX.
11. Calloway TB, 2000. *Characterization of Melter Off Gas Condensate from the Duratek LAW Pilot Melter Off Gas System*, WSRC-TR-2000-00299, Westinghouse Savannah River Company, Aiken, SC.
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15. Haynes International, 2002. Hastelloy® C-22® Technical Bulletin, Kokomo, Indiana,

Additional Reading

- 24590-LAW-M6-LOP-00001002, *P&ID - LAW LAW Primary Offgas Process System Melter 1 LOP-VSL-00001*.
- 24590-LAW-M6-LOP-00002002, *P&ID - LAW LAW Primary Offgas Process System Melter 2 LOP-VSL-00002*.
- 24590-LAW-MPD-LOP-00007, *24590-LAW-MP-LOP-PMP-00001, -00002, -00004, -00005 - MELTER 1 and 2 SBS Condensate Purge Pumps.*
- 24590-LAW-MVD-LOP-00004, *24590-LAW-MY-LOP-EUDC-00001 - LAW Melter 1 SBS Condensate Vessel Mechanical Data Sheet: Vessel.*
- 24590-LAW-MVD-LOP-00005, *24590-LAW-MY-LOP-EUDC-00002 - LAW Melter 2 SBS Condensate Vessel Mechanical Data Sheet: Vessel.*
- 24590-WTP-RPT-M-04-0008, *Evaluation Of Stainless Steel and Nickel Alloy Wear Rates In WTP Waste Streams At Low Velocities.*
- Agarwal, DC, *Nickel and Nickel Alloys*, In: Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158.
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CORROSION EVALUATION

PROCESS CORROSION DATA SHEET (extract)

Component(s) (Name/ID #) **Condensate Vessels (LOP-VSL-00001/2)**

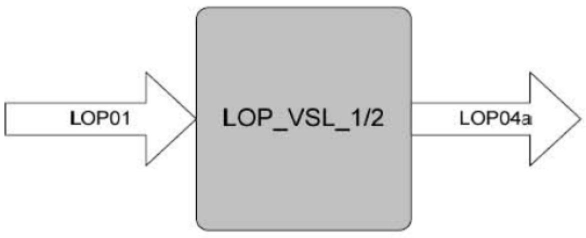
Facility	LAW
In Black Cell?	NO

Chemicals	Unit	Stream ID LOP04a AQUEOUS
Cations (ppm)		
Al^{+3} (Aluminum)	ppm	495
Fe^{+3} (Iron)	ppm	573
Hg^{+2} (Mercury)	ppm	0
Pb^{+2} (Lead)	ppm	24
Anions (ppm)		
Cl^{-} (Chloride)	ppm	3677
CO_3^{-2} (Carbonate)	ppm	0
F^{-} (Fluoride)	ppm	7625
NO_2^{-} (Nitrate)	ppm	0
NO_3^{-} (Nitrite)	ppm	0
PO_4^{-3} (Phosphate)	ppm	32
SO_4^{-2} (Sulfate)	ppm	3040
$OH(aq)^{-}$	ppm	763
$OH(s)^{-}$	ppm	0
pH		0.72
Suspended Solids	wt%	0
Temperature	°F	140

Figure C- 10 LOP-VSL-00001/2 Aqueous PCDS

Vessel : LOP_VSL_1/2

	Stream ID	
	LOP01	LOP04a
Properties		
Suspended Solids [wt %]	0	0
Total Salts [wt %]	4.70	2.72
Sodium Molarity [M]	8.92E-06	2.00E-01
Relative Humidity [%]	n/a	n/a
pH	0.17	0.72
Anti-Foam Agent [ppm]	5.43E-07	1.85E-06
TOC [kg/h]	1.66E-01	5.33E+00
Pressure [bar]	0.96	0.89
Temperature [C]	60.00	60.00
Temperature [F]	140.00	140.00
Water Flow Rate [kg/hr]	18,032.97	18,033.66
Total Aqueous Flow Rate [kg/hr]	18921.83	18538.67
Total Flow Rate [kg/hr]	1.89E+04	1.85E+04
UserNote	VIT LIQUID SBS Condensate Overflow	VIT LIQUID LAW Liquid to LOP05_SPLIT



AQUEOUS	LOP01	LOP04a
Cations (ppm)		
Ag+	0	0
Al+3	105	495
Am+3	0	0
As+5	0	0
B+3	398	1857
Ba+2	0	0
Be+2	0	0
Bi+3	0	0
Ca+2	71	485
Cd+2	0	0
Ce+4	0	0
Co+2	0	0
Cr+3	0	0
Cr+6	38	145
Cs+	0	0
Cu+2	0	0
Eu+3	0	0
Fe+2	0	0
Fe+3	121	573
H+	666	237
Hg+2	0	0
K+	160	224
La+3	0	0
Li+	117	1346
Mg+2	2	20
Mn+4	0	0
Mo+6	0	0
Na+	12797	4587
Nd+3	0	0
Ni+2	1	10
Pb+2	0	24
Pd+2	0	0
Pr+4	0	0
Pu+4	0	0
Ra+2	0	0
Rb+	0	0
Rh+3	0	0
Ru+4	0	0
Sb+3	0	0
Se+4	3	5
Si+4	354	943
Sr+2	0	0
Ta+5	0	0
Tc+4	0	0
Te+4	0	0
Th+4	0	1
Ti+4	43	203
Tl+5	3	4
U+4	0	0
V+3	0	0
W+6	0	0
Y+3	0	0
Zn+2	134	629
Zr+4	7	35
Anions (ppm)		
B(OH)4-	0	0
C2O4-2	0	0
Cl-	10287	3677
CN-	0	0
CO3-2	0	0
F-	21332	7625
H2PO4-	0	0
H2SiO4-2	0	0
H3SiO4-	0	0
HCO3-	0	0
HPO4-2	0	0
HSO3-	0	0
HSO4-	0	0
I-	0	0
IO3-	0	0
NH4+	0	0
NO2-	0	0
NO3-	0	0
O-2	0	0
O2-2	0	0
OH(aq)-	0	759
OH(s)-	0	0
PO4-3	4	32
SO3-2	0	0
SO4-2	322	3040
Organics (ppm)		
AFA_DCMP	0	0
AFA_NVOC	0	0
NVOC	0	0
Sucrose	0	0
SVOC	9	287
VOC	0	0

GENERAL NOTE FOR USE OF PCDS:

- *The information provided by the PCDS report is intended solely for use in support of the vessel material selection process and Corrosion Evaluations. The inputs, assumptions, and computational/engineering models used in generating the results presented herein are specific to this effort. Use of the information presented herein for any other purpose will require separate consideration and analysis to support justification of its use for the desired, alternative purpose.*
- *The process descriptions in this report cover routine process operations and non-routine (infrequent) process operations, when such exist, that could impact corrosion or erosion of process equipment.*
- *The data in the non-shaded columns of the PCDSs has NOT been adjusted to comply with the highest expected, vessel-specific operational conditions.*
- *The process descriptions provided in this report are for general information and reflective of the corrosion engineer's analysis for transparency, the information is current only at the time this document is issued. These process descriptions should not be referenced for design.*

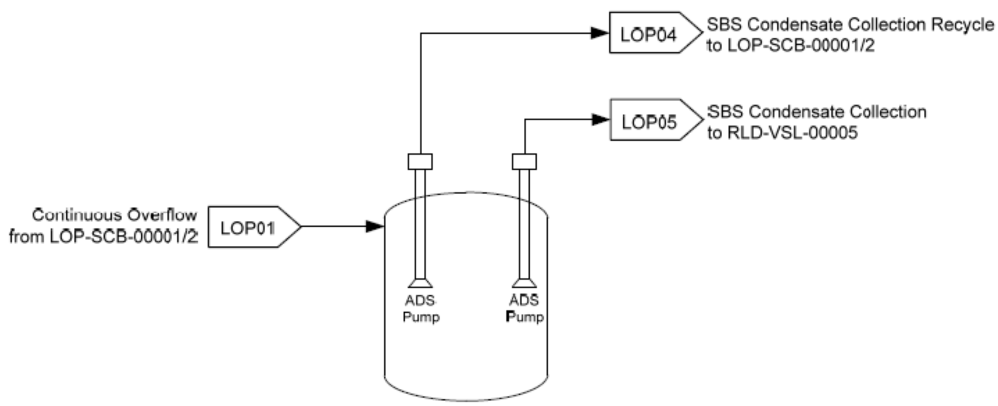
6.4.1 Description of Vessel/Equipment

The LAW primary offgas process (LOP) system is designed to treat the offgas so that it conforms to relevant federal, state, and local air emissions requirements at the point of discharge from the facility stack. The principal gas generated by the melter is steam. Decomposition of salts and organic material also yields CO_2, SO_2, NO_x, HCl, and HF. The NO_x is a mixture of NO and NO_2 with trace amounts of N_2O.

The SBS receives offgas from the melter film cooler with the purpose of removing solids and cooling the offgas stream. For interim storage capacity of the condensed fluids, the SBS overflows to the SBS condensate vessels (LOP-VSL-O0001/2). The SBS condensate vessels are used as buffer containers for the accumulating SBS condensate fluids while recycling the condensate fluids back to the SBS, facilitating the cooling of the columns and maintaining the column liquid level. The SBS condensate vessels have liquid-liquid eductors that are motivated by the recirculation pump system to sustain the recycle of condensate. The SBS condensate vessels are connected to the offgas system and are operated under partial vacuum.

Figure 8 is a sketch of the input and output arrangement of streams for LOP-VSL-00001/2.

Figure 8 LOP-VSL-00001/2 Sketch



6.4.2 System Functions

The process functions of this vessel are as follows:

- Receive SBS Condensate
- Transfer SBS Condensate to RLD-VSL-00005

These vessels perform additional system functions beyond the process functions, but these are outside the scope of this document. The non-process functions are not discussed any further in this document. However, they are listed below for completeness:

- Confine Hazardous Materials
- Flush System Components
- Report System Data

6.4.3 Description of Process Functions

6.4.3.1 Receive SBS Condensate

The following process streams taken from Process Flow Diagram 24590-LAW-M5-V17T-00007/8 (Ref. 7.1.3(15)(16)) and associated drawing change notices (DCNs):

- LOP01 - SBS condensate from LOP-SCB-00001/2

6.4.3.1.1 LOP01 - SBS condensate from LOP-SCB-00001/2

Stream LOP01 is the submerged bed scrubber, LOP-SCB-00001/2, condensate overflow sent to the SBS condensate vessel, LOP-VSL-00001/2.

Molarity
The sodium concentration of LOP01 may range from 0.1 to 0.2 M (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)). The nominal sodium concentration is the average of this range, 0.15 M and the maximum sodium concentration for stream LOP05 is 0.2 M.

Temperature
The nominal temperature of stream LOP01 ranges from 121 to 122°F (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)). The minimum temperature is 104°F and the maximum is 140°F (24590-LAW-MVC-LOP-00001, Section 6.1, Ref. 7.1.4(21)). Therefore, 122°F is considered nominal temperature and 140°F is considered upper highest expected temperature for stream LOP01.

Solids Concentration
The solids will range from 0.2 to 0.3 wt% UDS (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)). The nominal solids concentration for stream LOP01 is the average of this range, 0.25 wt% UDS.

Slurry Density
The minimum and maximum density of stream LOP01 is 62.2 lb/ft^3 to 62.8 lb/ft^3 , respectively (24590-LAW-MVC-LOP-00001, Section 7.6.2, Ref. 7.1.4(21)). The normal slurry density is the average of this range, 62.5 lb/ft^3.

Slurry pH
The resulting pH for this stream will be provided in the corrosion data sheet.

6.4.3.2 Transfer SBS condensate to RLD

The following process streams taken from Process Flow Diagram 24590-LAW-M5-V17T-00007/8 (Ref. 7.1.3(15)(16)) and associated DCNs are outputs from LOP-VSL-00001/2:

- LOP05 - Transfer SBS condensate to RLD-VSL-00005
- LOP04 - Recycle SBS condensate to LOP-SCB-00001/2

6.4.3.2.1 LOP05 - Transfer SBS condensate to RLD-VSL-00005

Stream LOP05 is the submerged bed scrubber, LOP-SCB-00001, condensate purge to RLD-VSL-00005.

Molarity
The sodium concentration of LOP05 may range from 0.1 to 0.2 M (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)). The nominal sodium concentration is the average of this range, 0.15 M and the upper sodium concentration for stream LOP05 is 0.2 M.

Temperature
The nominal temperature of stream LOP05 ranges from 121 to 122 °F (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)). The minimum temperature is 104°F and the maximum is 140°F (24590-LAW-MVC-LOP-00001, Section 6.1, Ref. 7.1.4(21)). Therefore, 122°F is considered nominal temperature and 140°F is considered upper highest expected temperature for stream LOP05.

Solids Concentration
The solids will range from 0.2 to 0.3 wt% UDS (24590-WTP-DB-PET-09-001, Table B-19, Ref. 7.1.1(3)). The nominal solids concentration for stream LOP05 is the average of this range, 0.25 wt% UDS.

Slurry Density
The minimum and maximum density of stream LOP05 is 62.2 lb/ft^3 to 62.8 lb/ft^3 , respectively (24590-LAW-MVC-LOP-00001, Section 7.6.2, Ref. 7.1.4(21)). The normal slurry density is the average of this range, 62.5 lb/ft^3.

Slurry pH
The resulting pH for this stream will be provided in the corrosion data sheet.

6.4.3.2.2 LOP04 - Recycle SBS condensate to LOP-SCB-00001/2

Recycle of SBS condensate back to LOP-SCB-00001/2 has the same properties as LOP05.

24590-WTP-RPT-PR-04-0001-04, Rev. 0A
WTP Process Corrosion Data – Volume 4

6.4.4 Process Modes

6.4.4.1 Normal Operations

Based on the assessment of streams frequently transferred in and out of LOP-VSL-00001/2, three normal processing modes are considered:

1) Receipt of SBS condensate from LOP-VSL-00001/2
2) Recycle of SBS condensate back to LOP-SCB-00001/2
3) Transfer of SBS condensate to RLD-VSL-00005

Section 6.4.5.1 summarizes in tabular form each of these processing modes.

6.4.4.2 Infrequent Operations

There are no infrequent operations identified for LOP-VSL-00001/2.

6.4.5 Summary of Processing Conditions for LOP-VSL-00001/2

6.4.5.1 Normal Operations

The following table summarizes the normal processing mode for vessel LOP-VSL-00001/2 where the vessel receive SBS condensate from LOP-SCB-00001/2 and transfers SBS condensate to RLD-VSL-00005.

Summary of LOP-VSL-00001/2 Normal Waste Conditions for Processing

Stream Number	Weight % UDS		Na Molarity		Temperature (°F)	
	normal	upper	normal	upper	normal	upper
LOP01	0.25	0.3	0.15	0.2	122	140
LOP04	0.25	0.3	0.15	0.2	122	140
LOP05	0.25	0.3	0.15	0.2	122	140

6.4.5.2 Infrequent Operations

None identified.

Table III.10.E.B – LAW Vitrification Plant Tank Systems Description

Dangerous and/or Mixed Waste Tank Systems Name	Unit Designation	Engineering Description (Drawing Nos, Specification Nos, etc.)	Narrative Description, Tables & Figures	Maximum Capacity (gallons)
LOP-VSL-00001 (LAW Melter 1 SBS Condensate Vessel) LOP-VSL-00002 (LAW Melter 2 SBS Condensate Vessel)		-M6-LOP-00001002 -M6-LOP-00002002 -MV-LOP-P0001 -MV-LOP-P0002 -MVD-LOP-00004 -MVD-LOP-00005 -N1D-LOP-~~P~~00002 -P1-P01T-00002		LOP-VSL-00002 = 9,056
LAW Vitrification Plant Radioactive Liquid Waste Disposal System RLD-VSL-00003 (Plant Wash Vessel) RLD-VSL-00004 (C3/C5 Drains/Sump Collection Vessel) RLD-VSL-00005 (SBS Condensate Collection Vessel)	RLD	**24590-LAW** -M5-V17T-00014 -M6-RLD-00001001 -M6-RLD-00001002 -M6-RLD-00001003 -M6-RLD-00001004 -M6-RLD-00001005 -M6-RLD-00001006 -M6-RLD-00002001 -M6-RLD-00002002 -M6-RLD-00002003 -M6-RLD-00002004 -M6-RLD-00002005 -M6-RLD-00003001 -M6-RLD-00003002 -M6-RLD-00003003	Section 4E.2.3; Tables 4E-1 and 4E-3; and Figures 4A-1 and 4A-3 of Operating Unit Group 10, Chapter 4 of this Permit.	RLD-VSL-00003 = 25,680 RLD-VSL-00004 = 7,675 RLD-VSL-00005 = 25,670

Table III.10.H.A – LAW Plant Miscellaneous Unit System Description

Sub-system Description	Sub-system Designation	Engineering Description (Drawing Nos., Specification Nos., etc.)	Narrative Description, Tables and Figures
LOP-FCLR-00004 (Melter 2 Standby Film Cooler)			
LAW Primary Offgas Process System (Cont.) LOP-SCB-00001 (Melter 1 Submerged Bed Scrubber) LOP-SCB-00002 (Melter 2 Submergered Bed Scrubber)	LOP	**24590-LAW** -M5-V17T-P0007 -M5-V17T-P0008 -M6-LOP-00001001 -M6-LOP-00002001 -MK-LOP-P0001001 -MK-LOP-P0001002 -MK-LOP-P0001003 -MKD-LOP-00008 -NID-LOP-~~P~~00001 -P1-P01T-00002	Section 4E.4.2.1, Table 4E-2, and Figures 4A-1 and 4A-3 in Operating Unit Group 10, Chapter 4 of this Permit.
LAW Primary Offgas Process System (Cont.) LOP-WESP-00001 (Melter 1 Wet Electrostatic Precipitator – WESP) LOP-WESP-00002 (Melter 2 Wet Electrostatic Precipitator – WESP)	LOP	**24590-LAW** -M5-V17T-P0007 -M5-V17T-P0008 -M6-LOP-00001004 -M6-LOP-00002004 -NID-LOP-00003 -P1-P01T-00002 **24590-WTP** -3PS-MKE0-T0001 24590-QL-POA-MKE0-00001-06-32	Section 4E.4.2.1, Table 4E-2, and Figures 4A-1 and 4A-3 in Operating Unit Group 10, Chapter 4 of this Permit.

Table III.10.E.B – LAW Vitrification Plant Tank Systems Description

Dangerous and/or Mixed Waste Tank Systems Name	Unit Designation	Engineering Description (Drawing Nos, Specification Nos, etc.)	Narrative Description, Tables & Figures	Maximum Capacity (gallons)
LOP-VSL-00001 (LAW Melter 1 SBS Condensate Vessel) LOP-VSL-00002 (LAW Melter 2 SBS Condensate Vessel)		-M6-LOP-00001002 -M6-LOP-00002002 -MV-LOP-P0001 -MV-LOP-P0002 -MVD-LOP-00004 -MVD-LOP-00005 -N1D-LOP-~~P~~00002 -P1-P01T-00002		LOP-VSL-00002 = 9,056
<u>LAW Vitrification Plant Radioactive Liquid Waste Disposal System</u> RLD-VSL-00003 (Plant Wash Vessel) RLD-VSL-00004 (C3/C5 Drains/Sump Collection Vessel) RLD-VSL-00005 (SBS Condensate Collection Vessel)	RLD	**<u>24590-LAW</u>** -M5-V17T-00014 -M6-RLD-00001001 -M6-RLD-00001002 -M6-RLD-00001003 -M6-RLD-00001004 -M6-RLD-00001005 -M6-RLD-00001006 -M6-RLD-00002001 -M6-RLD-00002002 -M6-RLD-00002003 -M6-RLD-00002004 -M6-RLD-00002005 -M6-RLD-00003001 -M6-RLD-00003002 -M6-RLD-00003003	Section 4E.2.3; Tables 4E-1 and 4E-3; and Figures 4A-1 and 4A-3 of Operating Unit Group 10, Chapter 4 of this Permit.	RLD-VSL-00003 = 25,680 RLD-VSL-00004 = 7,675 RLD-VSL-00005 = 25,670

Table III.10.H.A – LAW Plant Miscellaneous Unit System Description

Sub-system Description	Sub-system Designation	Engineering Description (Drawing Nos., Specification Nos., etc.)	Narrative Description, Tables and Figures
LOP-FCLR-00004 (Melter 2 Standby Film Cooler)			
LAW Primary Offgas Process System (Cont.) LOP-SCB-00001 (Melter 1 Submerged Bed Scrubber) LOP-SCB-00002 (Melter 2 Submergered Bed Scrubber)	LOP	**24590-LAW** -M5-V17T-P0007 -M5-V17T-P0008 -M6-LOP-00001001 -M6-LOP-00002001 -MK-LOP-P0001001 -MK-LOP-P0001002 -MK-LOP-P0001003 -MKD-LOP-00008 -NID-LOP-~~P~~000001 -P1-P01T-00002	Section 4E.4.2.1, Table 4E-2, and Figures 4A-1 and 4A-3 in Operating Unit Group 10, Chapter 4 of this Permit.
LAW Primary Offgas Process System (Cont.) LOP-WESP-00001 (Melter 1 Wet Electrostatic Precipitator – WESP) LOP-WESP-00002 (Melter 2 Wet Electrostatic Precipitator – WESP)	LOP	**24590-LAW** -M5-V17T-P0007 -M5-V17T-P0008 -M6-LOP-00001004 -M6-LOP-00002004 -NID-LOP-00003 -P1-P01T-00002 **24590-WTP** -3PS-MKE0-T0001 24590-QL-POA-MKE0-00001-06-32	Section 4E.4.2.1, Table 4E-2, and Figures 4A-1 and 4A-3 in Operating Unit Group 10, Chapter 4 of this Permit.

Hanford Facility RCRA Permit Modification Notification Forms

Part III, Operating Unit 11
Integrated Disposal Facility

Index

Submitted by Co-Operator:		Reviewed by DOE Program Office:	
Signed per Telecon Paul W. Martin	June 9, 2020	Duane Carter Digitally signed by Duane Carter Date: 2020.06.09 13:34:37 -07'00'	June 9, 2020
Lorna Dittmer	Date	Duane Carter	Date

Hanford Facility RCRA Permit Modification Form

Unit:	Permit Part
Integrated Disposal Facility	***Part III, Operating Unit Group 11***

Description of Modification:

Addendum J.1, the contact information table in Section J.7.1, Building Emergency Director/Building Warden, needs to be changed:

FROM

TITLE	WORK LOCATION	WORK PHONE
ERDF Transportation Manager	MO-607	430-6320
ERDF Disposal Manager	Building 6250	308-2303
ERDF Operations Specialist	MO-607	280-0657
ERDF Facility Manager	MO-607	947-1651

TO

Building Emergency Director/ Building Warden	AUTHORITY	WORK LOCATION	WORK PHONE
IDF Field Work Supervisor	Primary	MO-607	280-0657
ERDF Facility Manager	1st Alternate	MO-607	947-1651
ERDF Transportation Manager	2nd Alternate	MO-607	430-6320
ERDF Disposal Manager	3rd Alternate	Building 6250	308-2303

WAC 173-303-830 Modification Class	Class 1	Class ¹1	Class 2	Class 3
Please mark the Modification Class:	X			

Enter relevant WAC 173-303-830, Appendix I Modification citation number:
B.6.d., Contingency Plan: Changes in name, address, or phone number of coordinators or others persons or agencies identified in the plan.
A.1., General Permit Provisions: Administrative and informational changes . . . .

Modification Concurrence: [X] Yes [ ] No

Reviewed by Ecology:

Schleif, Stephanie (ECY)
Digitally signed by Schleif, Stephanie (ECY)
Date: 2020.06.11 08:43:33 -07'00'

S. N. Schleif   Date

Hanford Facility RCRA Permit Modification Form	
Unit: *Integrated Disposal Facility*	Permit Part *Part III, Operating Unit Group 11*

Description of Modification:

Unit Specific Conditions, Section III.11.A is being revised to update change history information for Addendum J.1.

WAC 173-303-830 Modification Class	Class 1	Class ¹1	Class 2	Class 3
Please mark the Modification Class:	X			

Enter relevant WAC 173-303-830, Appendix I Modification citation number:

A.1., General Permit Provisions: Administrative and informational changes . . . .

Modification Concurrence: X Yes ☐ No

Reviewed by Ecology:

Schleif, Stephanie (ECY) Digitally signed by Schleif, Stephanie (ECY) Date: 2020.06.11 08:44:47 -07'00'

S. N. Schleif Date

Revision Instructions:

Revise Addendum J.1 to incorporate the changes shown herein.

Revise Unit Specific Conditions as shown herein.

From: Dittmer, Lorna M
To: Carter, Duane B; Martin, Paul W - CHPRC
Cc: Lawrence, Barry L
Subject: RE: PCN-IDF-2020-03 INFORMAL REVIEW to ECY 060420_with comment
Date: Tuesday, June 09, 2020 1:53:51 PM

Paul, please consider this email as my approval.

Thanks,

Lorna

From: Carter, Duane B <duane.carter@rl.doe.gov>
Sent: Tuesday, June 9, 2020 1:35 PM
To: Martin, Paul W - CHPRC <paul_w_martin@rl.gov>; Dittmer, Lorna M <lorna_m_dittmer@rl.gov>
Cc: Lawrence, Barry L <barry_l_lawrence@rl.gov>
Subject: RE: PCN-IDF-2020-03 INFORMAL REVIEW to ECY 060420_with comment

Signed.

DC

From: Martin, Paul W - CHPRC <paul_w_martin@rl.gov>
Sent: Tuesday, June 9, 2020 1:27 PM
To: Dittmer, Lorna M <lorna_m_dittmer@rl.gov>; Carter, Duane B <duane.carter@rl.doe.gov>
Cc: Lawrence, Barry L <barry_l_lawrence@rl.gov>
Subject: RE: PCN-IDF-2020-03 INFORMAL REVIEW to ECY 060420_with comment
Importance: High

Lorna and Duane,

If you can sign the attached and dated (6/9/2020) PCN, I will transmit the formal review package to Ecology via the NWP email address. I did not attach the other documents since there were no changes from Ecology.

Paul W. Martin
RCRA Subject Matter Expert
CHPRC Environmental Protection
Phone (509) 376-6620 / Cell 531-4489 / Fax 376-4336
Paul_W_Martin@RL.Gov
CH2MHill Plateau Remediation Company

INTEGRATED DISPOSAL FACILITY
ADDENDUM J.1
PRE-ACTIVE LIFE CONTINGENCY PLAN
CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
08/21/2018	PCN-IDF-2018-01 (8C.2018.Q3)
5/23/2016	8C.2016.Q1

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ADDENDUM J.1
PRE-ACTIVE LIFE CONTINGENCY PLAN

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ADDENDUM J.1
PRE-ACTIVE LIFE CONTINGENCY PLAN

TABLE OF CONTENTS

FIGURE

TABLE

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J.0 CONTINGENCY PLAN

The requirements in this Addendum apply during the "Pre-Active Life" of Integrated Disposal Facility (IDF). Pre-Active Life is not defined in the regulations, but refers to the facility maintenance period between final construction and the start of active life. The IDF will transition from "Pre-Active Life" to "Active Life" prior to receipt and disposal of dangerous waste as defined in Washington Administrative Code (WAC) 173-303-040. Once the IDF begins to receive dangerous waste, the requirements in Addendum J.1 are no longer applicable, and requirements in Addendum J.2 will be applicable.

The requirements for a contingency plan at IDF are satisfied in the following documents: portions of the Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit (Permit) Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02) and this Addendum.

The unit-specific building emergency plan (HNF-39903) also serves to satisfy a broad range of other requirements [e.g., Occupational Safety and Health Administration standards (29 CFR 1910), *Toxic Substance Control Act of 1976* (40 CFR 761) and U.S. Department of Energy Orders]. Therefore, revisions made to portions of this unit-specific building emergency plan that are not governed by the requirements of WAC 173-303 will not be considered as a modification subject to WAC 173-303-830 or Permit Condition I.C.3.

Table J.1 identifies the sections of the unit-specific building emergency plan written to meet WAC 173-303-350(3) contingency plan requirements. Section 12.0 of the unit-specific building emergency plan is written to meet WAC 173-303 requirements identifying where copies of Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02) and the building emergency plan are located and maintained on the Hanford Facility. Therefore, revisions to Addendum J require a Permit modification subject to WAC 173-303-830 and/or Permit Condition I.C.3.

Table J.1. Hanford Facility Documents Containing Contingency Plan Requirements of WAC 173-303-350(3)

Requirement	Permit Attachment 4, Hanford Emergency Management Plan (DOE/RL-94-02)	Building Emergency Plan[1] *(HNF-39903)*	Addendum J.1 IDF Pre-Active Life Contingency Plan
-350(3)(a) - A description of the actions which facility personnel must take to comply with this section and WAC 173-303-360.	X[2] Section 1.3.4	X[2] Sections 7.1, 7.2 through 7.2.5, and 7.3[3] Sections 4.0, 8.2, 8.3, 8.4, and 11.0	X[2] Sections J.3.1, J.3.2 through J.3.2.5, and J.3.3[3] Sections J.3, J.3.4, J.3.5, J.3.6, and J.5

Table J.1. Hanford Facility Documents Containing Contingency Plan Requirements of WAC 173-303-350(3)

Requirement	Permit Attachment 4, Hanford Emergency Management Plan (DOE/RL-94-02)	Building Emergency Plan[1] *(HNF-39903)*	Addendum J.1 IDF Pre-Active Life Contingency Plan
-350(3)(b) - A description of the actions which shall be taken in the event that a dangerous waste shipment, which is damaged or otherwise presents a hazard to the public health and the environment, arrives at the facility, and is not acceptable to the owner or operator, but cannot be transported pursuant to the requirements of WAC 173-303-370(5), Manifest system, reasons for not accepting dangerous waste shipments.	X[2] Section 1.3.4	X[2,4] Section 7.2.5.1	X[2,4] Section J.3.2.5.1
-350 (3)(c) - A description of the arrangements agreed to by local police departments, fire departments, hospitals, contractors, and state and local emergency response teams to coordinate emergency services as required in WAC 173-303-340(4).	X Sections 3.2.3, 3.3.1, 3.3.2, 3.4, 3.4.1.1, 3.4.1.2, 3.4.1.3, 3.7, and Table 3-1		
-350 (3)(d) - A current list of names, addresses, and phone numbers (office and home) of all persons qualified to act as the emergency coordinator required under WAC 173-303-360(1). Where more than one person is listed, one must be named as primary emergency coordinator, and others must be listed in the order in which they will assume responsibility as alternates. For new facilities only, this list may be provided to the department at the time of facility certification (as required by WAC 173-303-810(14)(a)(I)), rather than as part of the permit application.		X[5] Sections 3.1and 13.0	X[5] Sections J.2 and J.7
-350(3)(e) - A list of all emergency equipment at the facility (such as fire extinguishing systems, spill control equipment, communications and alarm systems, and decontamination equipment), where this equipment is required. This list must be kept up to date. In addition, the plan must include the location and a physical description of each item on the list, and a brief outline of its capabilities.		X Section 9.0	X Section J.4

Table J.1. Hanford Facility Documents Containing Contingency Plan Requirements of WAC 173-303-350(3)

Requirement	Permit Attachment 4, Hanford Emergency Management Plan (DOE/RL-94-02)	Building Emergency Plan[1] *(HNF-39903)*	Addendum J.1 IDF Pre-Active Life Contingency Plan
-350(3)(f) - An evacuation plan for facility personnel where there is a possibility that evacuation could be necessary. This plan must describe the signal(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes.	X[6] Figure 7-3 and Table 5-1	X[7] Section 1.5	X[7] Section J.1

An 'X' indicates requirement applies.

[1] Portions of Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02) not enforceable through Appendix A of that document are not made enforceable by reference in the building emergency plan.

[2] Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02) contains descriptions of actions relating to the Hanford Site Emergency Preparedness System. No additional description of actions is required at the site level. If other credible scenarios exist or if emergency procedures at the unit are different, the description of actions contained in the building emergency plan will be used during an event by a building emergency director.

[3] Sections 7.1, 7.2 through 7.2.5, and 7.3 of the building emergency plan are those sections subject to the Class 2 "Changes in emergency procedures (i.e., spill or release response procedures,)" described in WAC 173-303-830, Appendix I Section B.6.a.

[4] This requirement only applies to treatment, storage, and disposal (TSD) units that receive shipment of dangerous or mixed waste defined as offsite shipments in accordance with WAC 173-303.

[5] Emergency Coordinator names and home telephone numbers are maintained separate from any contingency plan document on file in accordance with Permit Condition II.A.4. and is updated, at a minimum, monthly.

[6] The Hanford Facility (Site-Wide) signals are provided in this document. No unit/building signal information is required unless unique devices are used at the unit/building.

[7] An evacuation route for the TSD unit must be provided. Evacuation routes for occupied buildings surrounding the TSD unit are provided through information boards posted within buildings.

J.1 Building Evacuation Routing

Figure J.1 provides identification of the primary and secondary staging areas and a general layout of the IDF. Alternate evacuation routes will be used on a case-by-case basis based on meteorological conditions at the time of the event.

J.2 Building Emergency Director/Building Warden (BED/BW)

Emergency response will be directed by the BED/BW until the Incident Commander (IC) arrives. The Incident Command System (ICS) and staff with supporting on-call personnel fulfill the responsibilities of the Emergency Coordinator as discussed in WAC 173-303-360. During events, IDF personnel perform response duties under the direction of the BED/BW. The Incident Command Post (ICP) is managed by the senior Hanford Fire Department official, unless the event is determined to be primarily a security event, in which case the Hanford Fire Department and Hanford Patrol will operate under a unified command system with Hanford Patrol making all decisions pertaining to security. These individuals are designated as the IC, and as such, have the authority to request and obtain any resources necessary for protecting people and the environment.

The BED/BW becomes a member of the ICP and functions under the direction of the IC. In this role, the BED/BW continues to manage and direct IDF operations.

A listing of BED/BWs by title, work location, and work telephone number is contained in Section J.7.1 of this plan. The BED/BW is on the premises or is available through "on-call" list 24-hours a day. Names and home telephone numbers of the BED/BWs are available from the Patrol Operations Center (POC) in accordance with Permit Condition II.A.4.

J.3 Implementation of the Plan

In accordance with WAC 173-303-360(2)(b), the BED/BW ensures that trained personnel identify the character, source, amount, and areal extent of the release, fire, or explosion to the extent possible. Identification of waste can be made by activities that can include, but are not limited to, visual inspection of dangerous waste, sampling activities in the field, reference to inventory records, or by consulting with facility personnel. Samples of materials involved in an emergency might be taken by qualified personnel and analyzed as appropriate. These activities must be performed with a sense of immediacy and shall include available information.

The BED/BW shall use the following guidelines to determine if an event has met the requirements of WAC 173-303-360(2)(d):

1. The event involved an unplanned spill, release, fire, or explosion,

AND

2.a. The unplanned spill or release involved a dangerous waste, or the material involved became a dangerous waste as a result of the event (e.g., product that is not recoverable.),

OR

2.b. The unplanned fire or explosion occurred at the IDF or transportation activity subject to RCRA contingency planning requirements,

AND

3. Time-urgent response from an emergency services organization was required to mitigate the event or a threat to human health or the environment exists.

As soon as possible, after stabilizing event conditions, the BED/BW shall determine, in consultation with the site contractor environmental single point-of-contact, if notification to the Washington State Department of Ecology (Ecology) is needed to meet WAC-173-303-360 (2)(d) reporting requirements. If all of the conditions under 1, 2, and 3 are met, notifications are to be made to Ecology. Additional information is found in Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), Section 4.2.

If review of all available information does not yield a definitive assessment of the danger posed by the incident, a worst-case condition will be presumed and appropriate protective actions and notifications will be initiated. The BED/BW is responsible for initiating any protective actions based on their best judgment of the incident.

The BED/BW must assess each incident to determine the response necessary to protect the personnel, facility, and the environment. If assistance from Hanford Patrol, Hanford Fire Department, or ambulance units is required, the Hanford Emergency Response Number (911 from site office phones/373-0911 from cellular phones) must be used to contact the POC and request the desired assistance. To request other resources or assistance from outside the IDF, the POC business number is used (373-3800).

J.3.1 Protective Actions Responses

Protective action responses are discussed in the following sections. The steps identified in the following description of actions do not have to be performed in sequence because of the unanticipated sequence of incident events.

J.3.1.1 Evacuation

If an evacuation is ordered or the evacuation siren sounds in the area of the IDF, personnel will proceed to the staging area.

The BED/BW or staging area manager directs the evacuation; however, to ensure that evacuations can be conducted promptly and safely, all personnel must be familiar with the evacuation procedure.

Area evacuations are rapid or controlled and the differences between them are pointed out in the following steps. When possible, these steps must be performed concurrently.

Area Evacuation Procedure
Halt any operations or work and place equipment and structures in a safe condition. Use emergency shutdown procedures for rapid evacuation.
Use whatever means are available (portable radios, bullhorns, runners, etc.) to pass the evacuation information to personnel.
Evacuate personnel to the staging area; group personnel as follows: potentially contaminated protective clothing, keys immediately available for vehicles, and those needing rides. Assist personnel that are temporarily/permanently disabled.
Conduct personnel accountability. If unable to account for personal, report personnel accountability results to the Hanford Emergency Operations Center (Hanford-EOC).
Inform IC of any potentially affected personnel (i.e., injured, contaminated, exposed, etc.) once the IC arrives at the ICP.
Relay pertinent evacuation information (routes, destination etc.) to drivers.
Dispatch vehicles as soon as the vehicles are loaded.
Report status to the Hanford-EOC, request additional transportation if required, and report if any personnel remain who are performing late shutdown duties.

J.3.1.2 Take Cover

When the Take Cover Alarm is activated, personnel will take cover in the nearest suitable building or trailer.

A message followed by the Take Cover siren is transmitted over the area emergency sirens. The following actions must be taken or considered:

- Shut doors and windows and wait for further instructions.
- Secure ventilation system.
- Follow normal exit procedures from radiological areas.
- Lock up classified documents and prepare for a possible evacuation.
- Report your location to the Accountability Aid or the BED/BW.
- Accountability Aides will provide accountability status to the Staging Area Manager for IDF personnel during an event.
- Inform IC of any potentially affected personnel (i.e., injured, contaminated, exposed, etc.) once the IC arrives at the ICP.

J.3.2 Response to Facility Operations Emergencies

Depending on the severity of the event, the BED/BW reviews the site-wide and IDF emergency response procedure(s) and, as required, categorizes and/or classifies the event. If necessary, the BED/BW initiates area protective actions and Hanford Site Emergency Response Organization activation. The steps identified in the following description of actions do not have to be performed in sequence because of the unanticipated sequence of incident events.

J.3.2.1 Loss of Utilities

The only loss of utilities is electrical. Loss of electricity does not constitute an emergency, but must be restored as soon as possible. Electricity supplies power to the sump pumps used to remove accumulated leachate from the primary and secondary liners. The loss of water, ventilation, steam, air, and vacuum are not applicable to the IDF.

J.3.2.2 Major Process Disruption/Loss of Plant Control

N/A

J.3.2.3 Pressure Release

N/A

J.3.2.4 Fire and/or Explosion

In the event of a fire, the discoverer activates a fire alarm (pull box); calls 911 from site office phones/373-0911 from cellular phones or verifies that the Hanford Emergency Response Number has been called.

- Unless otherwise instructed, personnel shall evacuate the area/building by the nearest safe exit and proceed to the designated staging area for accountability.
- On actuation of the fire alarm, ONLY if time permits, personnel should shut down equipment and secure waste. The alarm automatically signals the Hanford Fire Department.
- The BED/BW proceeds directly to the ICP, obtains all necessary information pertaining to the incident, and sends a representative to meet Hanford Fire Department.
- The BED/BW provides a formal turnover to the IC when the IC arrives at the ICP.
- The BED/BW informs the Hanford Site Emergency Response Organization as to the extent of the emergency (including estimates of dangerous waste and mixed waste quantities released to the environment).
- If operations are stopped in response to the fire, the BED/BW ensures that systems are monitored for leaks, pressure buildup, gas generation, and ruptures.
- Hanford Fire Department firefighters extinguish the fire as necessary.

J.3.2.5 Hazardous Material, Dangerous and/or Mixed Waste Spill

Spills can result from many sources including process leaks, container spills or leaks, damaged packages or shipments, or personnel error. Spills of mixed waste are complicated by the need to deal with the extra hazards posed by the presence of Atomic Energy Act materials.

- The discoverer notifies the BED/BW and initiates SWIMS response:
  - Stops work.
  - Warns others in the vicinity.
  - Isolates the area.
  - Minimizes the exposure to the hazards.
  - Requests the BED/BW Secure ventilation.

- The BED/BW determines if emergency conditions exist requiring response from the Hanford Fire Department based on classification of the spill and injured personnel, and evaluates need to perform additional protective actions.
- If the Hanford Fire Department resources are not needed, the spill is mitigated with resources identified in Section J.4.5 and proper notifications are made.
- If the Hanford Fire Department resources are needed, the BED/BW calls 911 from site office phones/373-0911 from cellular phones.
- The BED/BW sends a representative to meet the Hanford Fire Department.
- The BED/BW provides a formal turnover to the IC when the IC arrives at the ICP.
- The BED/BW informs the Hanford Site Emergency Response Organization as to the extent of the emergency (including estimates of dangerous waste and mixed waste quantities released to the environment).
- If operations are stopped in response to the spill, the BED/BW ensures that systems are monitored for leaks, pressure buildup, gas generation, and ruptures.
- Hanford Fire Department stabilizes the spill.

J.3.2.6 Damaged or Unacceptable Shipments

The IDF does not receive onsite transfers or off-site shipments of dangerous and/or mixed waste.

J.3.3 Prevention of Recurrence or Spread of Fires, Explosions, or Releases

The BED/BW, as part of the ICP, takes the steps necessary to ensure that a secondary release, fire, or explosion does not occur. The BED/BW takes measures, where applicable, to stop processes and maintenance activities, collect and contain released waste, and remove or isolate containers. The BED/BW shall also monitor for leaks, pressure buildups, gas generation, or ruptures in valves, pipes or other equipment, whenever this is appropriate.

J.3.4 Termination of Event, Incident Recovery, Restart of Operations

Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), Section 9.0, describes actions for event termination, incident recovery, and restart of operations. The extent by which these actions are employed is based upon the incident classification of each event. In addition, Permit Attachment 4, *Hanford Emergency Management Plan (*DOE/RL-94-02), also contains actions for the management of incompatible waste that might apply.

J.3.4.1 Termination of Event

For events where the Hanford Emergency Operations Center (Hanford-EOC) is activated, the Department of Energy-Richland (DOE-RL) or Department of Energy-Office of River Protection (DOE-ORP) Emergency Manager has the authority to declare event termination. This decision is based on input from the BED/BW, IC, and other emergency response organization members. For events where the Hanford-EOC is not activated, the ICS and staff will declare event termination.

J.3.4.2 Incident Recovery and Restart of Operations

A recovery plan is developed when necessary in accordance with Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), Section 9.2. A recovery plan is needed following an event where further risk could be introduced to personnel, the IDF, or the environment through recovery action and/or to maximize the preservation of evidence.

If this plan was implemented according to Section J.3, Ecology is notified before operations can resume. Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), Section 5.1, discusses different reports to outside agencies. This notification is in addition to those required reports and must include the following statements:

- There are no incompatibility issues with the waste and released materials from the incident.
- All the equipment has been cleaned, fit for its intended use, and placed back into service.

The notification required by WAC 173-303-360(2)(j) may be made via telephone conference. Additional information that Ecology requests regarding these restart conditions will be included in the required 15-day report identified in Section J.5.

For emergencies not involving activation of the Hanford-EOC, the BED/BW ensures that conditions are restored to normal before operations are resumed. If the Hanford Site Emergency Response Organization was activated and the emergency phase is complete, a special recovery organization could be appointed at the discretion of DOE-RL to restore conditions to normal. This process is detailed in DOE-RL and contractor emergency procedures. The makeup of this organization depends on the extent of the damage and the effects. The onsite recovery organization will be appointed by the appropriate contractor's management.

J.3.5 Incompatible Waste

After an event, the BED/BW or the onsite recovery organization ensures that no waste that might be incompatible with the released material is treated, stored, and/or disposed of until cleanup is completed. Clean up actions are taken by IDF personnel or other assigned personnel. Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), Section 9.2.3, describes actions to be taken.

Waste from cleanup activities is designated and managed as newly generated waste. A field check for compatibility is performed before storage, as necessary. Incompatible wastes are not placed in the same container. Containers of waste are placed in approved storage areas appropriate for their compatibility class.

If incompatibility of waste was a factor in the incident, the BED/BW or the onsite recovery organization ensures that the cause is corrected.

J.3.6 Post Emergency Equipment Maintenance and Decontamination

All equipment used during an incident is decontaminated (if practicable) or disposed of as spill debris. Decontaminated equipment is checked for proper operation before storage for subsequent use. Consumables and disposed materials are restocked. Spent fire extinguishers are replaced.

The BED/BW ensures that all equipment is cleaned and fit for its intended use before operations are resumed. Depleted stocks of neutralizing and absorbing materials are replenished, and protective clothing is cleaned or disposed of and restocked, etc.

J.4 Emergency Equipment

Emergency resources and equipment for the IDF are presented in this section.

J.4.1 Fixed Emergency Equipment

Fixed Emergency Equipment		
Type	**Location**	**Capability**
6 Inch Fire Hydrants	IDF	Fire suppression

J.4.2 Portable Emergency Equipment

Portable Emergency Equipment		
Type	**Location**	**Capability**
Fire extinguishers	In motorized equipment (e.g., trucks, etc.), nearby structures (e.g., change trailers, storage buildings, etc.).	Use on any Class A, B, or C fires. (Note: Some are only B and C.) Do NOT use on sodium.

J.4.3 Communications Equipment/Warning Systems

Communications Equipment		
Type	**Location**	**Capability**
Cell phones	Portable	Communication

NOTE: Site-wide communications and warning systems are identified in Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), Table 5.1.

J.4.4 Personal Protective Equipment

Personal Protective Equipment		
Type	**Location**	**Capability**
N/A		

J.4.5 Spill Control and Containment Supplies

Spill Kits and Spill Control Equipment		
Type	**Location**	**Capability**
N/A		

J.4.6 Incident Command Post

The ICPs for the IDF are in MO-518 and MO-607. Emergency resource materials are stored at each location. The IC could activate the Hanford Fire Department Mobile Command Unit if necessary.

J.4.7 Coordination Agreements

DOE-RL has established a number of coordination agreements, or memoranda of understanding (MOU) with various agencies to ensure proper response resource availability for incidents involving the Hanford Site. A description of the agreements is contained in Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), Section 3.0, Table 3-1.

J.5 Required Reports

Post incident written reports are required for certain incidents on the Hanford Site. The reports are described in Permit Attachment 4, *Hanford Emergency Management Plan*, (DOE/RL-94-02), Section 5.1.

Facility management must note in the TSD-unit operating record, the time, date, and details of any incident that requires implementation of the contingency plan (Section J.3). Within fifteen (15) days after the incident, a written report must be submitted to Ecology. The report must include the elements specified in WAC 173-303-360(2)(k).

J.6 Plan Location and Amendments

Copies of this plan are maintained at the following locations:

- MO-518
- MO-607

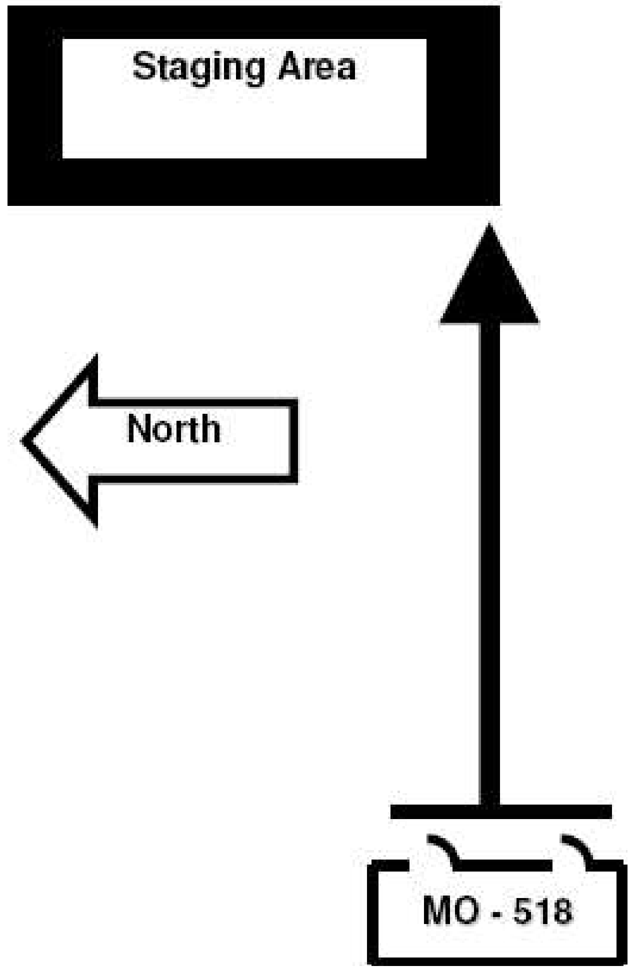
This plan is reviewed and immediately amended as necessary, in accordance with Permit Attachment 4, *Hanford Emergency Management Plan (*DOE/RL-94-02), Section 14.3.1.1.

J.7 Facility/Building Emergency Response Organization

J.7.1 Building Emergency Director/Building Warden

Building Emergency Director/Building Warden~~Title~~	Authority	Work Location	Work Phone
~~ERDF Operations Specialist~~ **IDF Field Work Supervisor**	**Primary**	MO-607	280-0657
ERDF Facility Manager	**1st Alternate**	MO-607	947-1651
ERDF Transportation Manager	**2nd Alternate**	MO-607	430-6320
ERDF Disposal Manager	**3rd Alternate**	Building 6250	308-2303

Names and home telephone numbers of the BED/BWs are available from the POC (373-3800) in accordance with Permit Condition II.A.4.



1 **Figure J.1. Evacuation Routes**

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J.6 Plan Location and Amendments

Copies of this plan are maintained at the following locations:

- MO-518
- MO-607

This plan is reviewed and immediately amended as necessary, in accordance with Permit Attachment 4, *Hanford Emergency Management Plan (*DOE/RL-94-02), Section 14.3.1.1.

J.7 Facility/Building Emergency Response Organization

J.7.1 Building Emergency Director/Building Warden

Building Emergency Director/Building Warden~~Title~~	Authority	Work Location	Work Phone
~~ERDF Operations Specialist~~ **IDF Field Work Supervisor**	**Primary**	MO-607	280-0657
ERDF Facility Manager	**1st Alternate**	MO-607	947-1651
ERDF Transportation Manager	**2nd Alternate**	MO-607	430-6320
ERDF Disposal Manager	**3rd Alternate**	Building 6250	308-2303

Names and home telephone numbers of the BED/BWs are available from the POC (373-3800) in accordance with Permit Condition II.A.4.

INTEGRATED DISPOSAL FACILITY
CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have a "**Last Modification Date**" which represents the last date the portion of the unit has been modified. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Last modification to Integrated Disposal Facility **August 21, 2018**

Chapters	Last Modification Date	Modification Number
Unit-Specific Conditions	08/21/2018	PCN-IDF-2018-01 (8C.2018.Q3)
1.0 Part A Form	10/01/2008	
2.0 Topographic Map Description	09/30/2014	
3.0 Waste Analysis Plan	06/30/2013	
4.0 Process Information	12/31/2008	
4A1 Phase I Critical Systems Design Report	08/25/2016	8C.2016.Q2
4A2 Critical Systems Tables & Data Sheets	03/31/2008	
4A3 Critical Systems Design Drawings	03/31/2008	
4B Detailed Design Cell 1 Construction Quality Assurance Plan	04/09/2006	
4C Facility Response Action Plan	04/09/2006	
4D Construction Specifications (C-1)	12/31/2006	
5.0 Groundwater Monitoring	06/30/2010	
6.0 Procedures to Prevent Hazards	06/20/2013	
7.0 Reserved		
8.0 Personnel Training	09/30/2014	
9.0 Reserved		
10.0 Reserved		
11.0 Closure	09/30/2014	
12.0 Reserved		
13.0 Other Federal and State Laws	04/09/2006	
Addenda	**Last Modification Date**	**Modification Number**
Addendum J.1 Pre-Active Life Contingency Plan	08/21/2018	PCN-IDF-2018-01 (8C.2018.Q3)
Addendum J.2 Active Life Contingency Plan	05/23/2016	8C.2016.Q1

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INTEGRATED DISPOSAL FACILITY
PART III, OPERATING UNIT 11 UNIT-SPECIFIC CONDITIONS
CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
08/21/2018	PCN-IDF-2018-01 (8C.2018.Q3)
08/25/2016	8C.2016.Q2

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PART III, OPERATING UNIT 11 UNIT-SPECIFIC CONDITIONS
INTEGRATED DISPOSAL FACILITY

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PART III, OPERATING UNIT 11 UNIT-SPECIFIC CONDITIONS INTEGRATED DISPOSAL FACILITY

This document sets forth the operating conditions for the Integrated Disposal Facility (IDF).

III.11.A COMPLIANCE WITH APPROVED PERMIT

The Permittees shall comply with all requirements set forth in the Integrated Disposal Facility (IDF) Permit conditions, the Chapters and Appendices specified in Permit Condition III.11.A and the Amendments specified in Permit Conditions III.11.B through III.11.I. All subsections, figures, and tables included in these portions are enforceable unless stated otherwise:

<u>OPERATING UNIT 11:</u>

Chapter 1.0	Part A Form, dated October 1, 2008
Chapter 2.0	Topographic Map Description, dated September 30, 2014
Chapter 3.0	Waste Analysis Plan, dated June 30, 2013
Chapter 4.0	Process Information, dated December 31, 2008
Appendix 4A	Design Report (as applicable to critical systems), dated June 30, 2016
Appendix 4B	Construction Quality Assurance Plan, dated April 9, 2006
Appendix 4C	Response Action Plan, dated April 9, 2006
Appendix 4D	Construction Specifications (RPP-18489, Rev. 1), dated December 31, 2006
Chapter 5.0	Ground Water Monitoring, dated June 30, 2010
Chapter 6.0	Procedure to Prevent Hazards, dated June 20, 2013
Addendum J.1	Contingency Plan – Pre-Active Life, dated ~~August 21, 2018~~<u>TBD</u>
Addendum J.2	Contingency Plan – Active Life, dated March 31, 2016
Chapter 8.0	Personnel Training, dated September 30, 2014
Chapter 11.0	Closure, dated September 30, 2014
Chapter 13.0	Other Federal and State Laws, dated April 9, 2006

General and Standard Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, WA7890008967 (Permit) conditions (Part I and Part II Conditions) applicable to the IDF are identified in Permit Attachment 9 (Permit Applicability Matrix).

III.11.B AMENDMENTS TO THE APPROVED PERMIT

III.11.B.1 Portions of Permit Attachment 4, *Hanford Emergency Management Plan* that are not made enforceable by inclusion in the applicability matrix for that document, are not made enforceable by reference in this document.

III.11.B.2 Permittees must comply with all applicable portions of the Permit. The facility and unit-specific recordkeeping requirements are distinguished in the General Information Portion of the Permit, and are tied to the Permit conditions.

III.11.B.3 The scope of this Permit is restricted to the landfill construction and operation as necessary to dispose of: 1) Immobilized Low Activity Waste (ILAW) from the WTP, and 2) the Demonstration Bulk Vitrification System (DBVS) and IDF operational waste as identified in Chapter 4.0. Future expansion of the RCRA trench, or disposal of other wastes not specified in this Permit, is prohibited unless authorized via modification of this Permit.

III.11.B.4 In accordance with WAC 173-303-806(11)(d), this Permit shall be reviewed every five (5) years after the effective date and modified, as necessary, in accordance with WAC 173-303-830(3).

III.11.B.5 Inspection Requirements – Pre-Active Life Period and Active Life Period

III.11.B.5.a The Permittees will conduct inspections of the IDF according to the following requirements:

III.11.B.5.a.i Prior to the start of the active life of the IDF as defined in WAC 173-303-040, according to Chapter 6.0, Table 6.2.

III.11.B.5.a.ii Following the start of the active life of the IDF as defined in WAC 173-303-040, according to Chapter 6.0, Table 6.2A.

III.11.B.5.b The Permittees will remedy any problems revealed by inspections conducted pursuant to Permit Condition III.11.B.5.a on a schedule, which prevents hazards to the public health and the environment and as agreed to in writing, by Ecology. Where a hazard is imminent or has already occurred, remedial action must be taken immediately.

III.11.B.5.c Reserved

III.11.B.5.d Rainwater Management

III.11.B.5.e Prior to the start of the active life of the IDF, the Permittees will manage the discharge of such water in accordance with the pollution prevention and best management practices required by State Waste Discharge Permit Number ST 4511.

III.11.B.5.e.i Management of Liquids Collected in the Leachate Collection and Removal System (LCRS), Leak Detection System (LDS), and Secondary Leak Detection System (SLDS) prior to the start of the active life of the IDF.

III.11.B.5.e.ii Permittees shall manage the liquid in the LCRS system in a manner that does not allow the fluid head to exceed 30.5 cm above the flat 50-foot by 50-foot LCRS sump High Density Polyethylene (HDPE) bottom liner, and the LCRS sump trough, except for storms that exceed the 25-year, 24-hour storm event [WAC 173-303-665(2)(h)(ii)]. Liquid with a depth greater than 30.5 cm above the LCRS liner will be removed at the earliest practicable time after detection (not to exceed 5 working days).

III.11.B.5.e.iii Accumulated liquid of pumpable quantities in the LDS and SLDS will be managed in a manner that does not allow the fluid head to exceed 30.5 cm above the LDS liner or SLDS liner [WAC 173-303-665(2)(h)(ii) and (iii)]. Liquid with a depth greater than 30.5 cm above a liner will be removed at the earliest practicable time after detection (not to exceed 5 working days).

III.11.B.5.e.iv The Permittees will use a flow meter to check if the amount of actual liquid pumped corresponds to the amount accumulated in the leachate collection tank to verify the proper function of the leachate collection and removal sump pumps with each use. The Permittees will document in the IDF portion of the facility operating record appropriate quality assurance/quality control requirements for selection and operation of the flow meter based on the required verification. In addition, the Permittees will evaluate the leachate transfer lines for freeze and thaw damage when ambient conditions may cause such damage to occur. The Permittees will document the methods and criteria used for purposes of this evaluation, along with an appropriate justification.

III.11.B.5.e.v The Permittee will inspect for liquids after significant rainfall events.

III.11.B.5.e.vi The Permittee will annually verify monitoring gauges and instruments are in current calibration; calibration will be performed annually or more frequently at intervals suggested by the manufacturer (refer to Chapter 4.0, §4.3.7.4).

III.11.B.5.f The Permittees will monitor liquids in the Leachate Collection and Removal System and Leak Detection System to ensure the action leakage rate (Chapter 4.0, Appendix 4A) is not exceeded.

III.11.B.5.g Soil Stabilization

Prior to the first placement of waste in the IDF, the Permittee will apply soil stabilization materials as needed to prevent soil erosion in and around the landfill.

III.11.C Design Requirements

III.11.C.1 IDF is designed in accordance with WAC 173-303-665 and WAC 173-303-640 as described in Chapter 4.0. Design changes impacting IDF critical systems shall be performed in accordance with Permit Conditions III.11.D.1.d.i and III.11.D.1.d.ii.

III.11.C.1.a IDF Critical Systems include the following: The LCRS, leachate collection tank (LCT), LDS, liner system (LS), and closure cap. H-2 Drawings for the LCRS, LCT, LDS, and LS are identified in Appendix 4A, Section 3 of this Permit. Drawings for the closure cap will be provided pursuant to Permit Condition III.11.C.1.c.

The Permittees shall construct and operate the IDF in accordance with all specifications contained in RPP-18489 Rev 0. Critical systems, as defined in the definitions section of the Site-Wide RCRA Permit, are identified in Appendix 4A, Section 1 of this Permit.

III.11.C.1.b Landfill Cap

At final closure of the landfill, the Permittees shall cover the landfill with a final cover (closure cap) designed and constructed [WAC 173-303-665(6), WAC 173-303-806(4)(h)] to: Provide long-term minimization of migration of liquids through the closed landfill; Function with minimum maintenance; Promote drainage and minimize erosion or abrasion of the cover; Accommodate settling and subsidence so that the cover's integrity is maintained; and have a permeability less than or equal to the permeability of any bottom liner system or natural sub soils present.

III.11.C.1.c Compliance Schedule

Proposed conceptualized final cover design is presented in Chapter 11, Closure Requirements. Six months prior to start of construction of IDF landfill final cover (but no later than 6 months prior to acceptance of the last shipment of waste at the IDF), the Permittees shall submit IDF landfill final cover design, specifications and Construction Quality Assurance (CQA) plan to Ecology for review and approval. No construction of the final cover may proceed until Ecology approval of the final design is given, through a permit modification.

III.11.C.1.d The Permittees shall notify Ecology at least sixty (60) calendar days prior to the date it expects to begin closure of the IDF landfill in accordance with WAC 173-303-610(c).

III.11.C.2 Design Reports

III.11.C.2.a New Tank Design Assessment Report

Permittees shall generate a written report in accordance with WAC 173-303-640(3)(a), providing the results of the leachate collection tank system design assessment. The report shall be reviewed and certified by an Independent Qualified Registered Professional Engineer (IQRPE)[1] in accordance with WAC-173-303-810(13)(a).

III.11.C.2.b Compliance Schedule

Permittees shall submit the leachate collection tank design assessment report to Ecology along with the IQRPE certification, prior to construction of any part of the tank system including ancillary equipment.

III.11.D CONSTRUCTION REQUIREMENTS

III.11.D.1 Construction Quality Assurance

III.11.D.1.a Ecology shall provide field oversight during construction of critical systems. In cases where an Engineering Change Notice (ECN) and/or Non Conformance Report (NCR) are required, Ecology and the Permittees shall follow steps for processing changes to the approved design per Permit Conditions III.11.D.1.d.i and III.11.D.1.d.ii.

III.11.D.1.b Permittees shall implement the CQA plan (Appendix 4B of the permit) during construction of IDF.

III.11.D.1.b.i The Permittees will not receive waste in the IDF until the owner or operator has submitted to Ecology by certified mail or hand delivery a certification signed by the CQA officer that the approved CQA plan has been successfully carried out and that the unit meets the requirements of WAC 173-303-665(2)(h) or (j); and the procedure in WAC 173-303-810(14)(a) has been completed. Documentation supporting the CQA officer's certification shall be furnished to Ecology upon request.

III.11.D.1.c Construction Inspection Reports

Permittees shall submit a report documenting the results of the leachate tank installation inspection. This report must be prepared by an independent, qualified installation inspector or a professional IQRPE either of whom is trained and experienced in the proper installation of tank systems or components. The Permittees will remedy all discrepancies before the tank system is placed in use. This report shall be submitted to Ecology 90 days prior to IDF operation and be included in the IDF Operating Record. [WAC 173-303-640(3)(h)].

III.11.D.1.d ECN/NCR Process for Critical Systems

Portions of the following conditions for processing engineering change notices and non-conformance reporting were extracted from and supersede Site-Wide General Permit Condition II.L.

III.11.D.1.d.i Engineering Change Notice for Critical Systems

During construction of the IDF, the Permittees shall formally document changes to the approved designs, plans, and specifications, identified in Appendices 4A, 4B, 4C, and 4D of this permit, with an ECN.

The Permittees shall maintain all ECNs in the IDF unit-specific Operating Record and shall make them available to Ecology upon request or during the course of an inspection. The Permittees shall provide to Ecology copies of proposed ECNs affecting any critical

[1] "Independent qualified registered professional engineer," as used here and elsewhere with respect to Operating Unit 11, means a person who is licensed by the state of Washington, or a state which has reciprocity with the state of Washington as defined in RCW 18.43.100, and who is not an employee of the owner or operator of the facility for which construction or modification certification is required. A qualified professional engineer is an engineer with expertise in the specific area for which a certification is given.

system within five (5) working days of initiating the ECN. Identification of critical systems is included in Permit Condition III.11.C.1 and Appendix 4A of this Permit. Within five (5) working days, Ecology will review a proposed ECN modifying a critical system and inform the Permittees whether the proposed ECN, when issued, will require a Class 1, 2, or 3 Permit modification.

III.11.D.1.d.ii Non-conformance Reporting for Critical Systems

III.11.D.1.d.ii.a During construction of the IDF, the Permittees shall formally document with a NCR, any work completed which does not meet or exceed the standards of the approved design, plans and specifications, identified in Appendices 4A, 4B, 4C and 4D of this Permit. The Permittees shall maintain all NCRs in the IDF unit-specific Operating Record and shall make them available to Ecology upon request, or during the course of an inspection.

III.11.D.1.d.ii.b The Permittees shall provide copies of NCRs affecting any critical or regulated system to Ecology within five (5) working days after identification of the nonconformance. Identification of critical systems is included in Permit Condition III.11.C.1 and Appendix 4A of this Permit. Ecology will review a NCR affecting a critical system and notify the Permittees within five (5) working days, in writing, whether a Permit modification is required for any nonconformance, and whether prior approval is required from Ecology before work proceeds, which affects the nonconforming item.

III.11.D.1.d.ii.c As-Built Drawings

Upon completing construction of IDF, the Permittees shall produce as-built drawings of the project, which incorporate the design and construction modifications resulting from all project ECNs and NCRs, as well as modifications made pursuant to WAC 173-303-830. The Permittees shall place the drawings into the Operating Record within twelve (12) months of completing construction.

III.11.D.2 The Permittees shall not reduce the minimum frequency of destructive testing less than one test per 500 feet of seam, without prior approval in writing from Ecology.

III.11.E GROUND WATER AND GROUND WATER MONITORING

Ground water shall be monitored in accordance with + and the provisions contained in the Ecology-approved facility ground water monitoring plan (Chapter 5.0). All wells used to monitor the ground water beneath the unit shall be constructed in accordance with the provisions of WAC 173-160.

III.11.E.1 Ground Water Monitoring Program

III.11.E.1.a Prior to initial waste placement in the IDF landfill, the Permittees shall sample all ground water monitoring wells in the IDF network twice quarterly for one first year to determine baseline conditions. For the first sampling event (and only the first), samples for each well will include all constituents in 40 CFR 264 Appendix IX. Thereafter, sampling will include only those constituents as specified in Chapter 5.0, Table 5-2: chromium (filtered and unfiltered the first year to compare results), specific conductance, TOC, TOX, and pH. Other constituents to be monitored but not statistically compared include alkalinity, anions, Inductively Coupled Plasma metals, and turbidity. These will provide important information on hydrogeologic characteristics of the aquifer and may provide indications of encroaching contaminants from other facilities not associated with IDF.

III.11.E.1.b After the baseline monitoring is completed, and data is analyzed, the Permittees and Ecology shall assess revisions to Chapter 5.0, Table 5-2. Subsequent samples will be collected annually and will include constituents listed in Table 5-2 as approved by Ecology. All data analysis will employ Ecology approved statistical methods pursuant to WAC 173-303-645. Changes to Chapter 5.0 will be subject to the permit modification procedures under WAC 173-303-830.

III.11.E.1.c All constituents used as tracers to assess performance of the facility through computer modeling should be sampled at least annually to validate modeling results. Groundwater monitoring data and analytes to be monitored will be reviewed periodically as defined in Chapter 5.0 of this Permit.

III.11.E.1.d Upon Ecology approval of the leachate monitoring plan, leachate monitoring and groundwater monitoring activities should be coordinated as approved by Ecology to form an effective and efficient means of monitoring the performance of the IDF facility.

III.11.E.1.e Groundwater monitoring data shall be reported to Ecology annually by July 31. The annual report shall include monitoring results for the 12-month period from January 1 through December 31.

III.11.F LEACHATE COLLECTION COMPONENT MANAGEMENT

Permittees shall design, construct, and operate all leachate collection systems to minimize clogging during the active life and post closure period.

III.11.F.1 Leachate Collection and Removal System

III.11.F.1.a At least 120 days prior to initial waste placement in the IDF, the Permittees shall submit a Leachate monitoring plan to Ecology for review, approval, and incorporation into the permit. Upon approval by Ecology, this plan will be incorporated into the Permit as a class [1]1 modification. The Permittees shall not accept waste into the IDF until the requirements of the leachate monitoring plan have been incorporated into this Permit.

III.11.F.1.b Leachate in the LCRS (primary sump) shall be sampled and analyzed monthly for the first year of operation of the facility and quarterly thereafter (pursuant to WAC 173-303-200). Additionally, leachate shall be sampled and analyzed to meet waste acceptance criteria at the receiving treatment storage and disposal facility.

III.11.F.1.c Permittees shall manage the leachate in the LCRS system in a manner that does not allow the fluid head to exceed 30.5 cm above the flat 50-foot by 50-foot LCRS sump HDPE bottom liner except for rare storm events as discussed in Chapter 4.0, §4.3.6.1 and the LCRS sump trough [WAC 173-303-665(2)(h)(ii)]. Liquid with a depth greater than 30.5 cm above the SLDS liner will be removed at the earliest practicable time after detection (not to exceed 5 working days).

III.11.F.1.d After initial waste placement, Permittees shall manage all leachate from the permitted cell as dangerous waste (designated with Dangerous Waste Number F039) in accordance with WAC 173-303.

III.11.F.2 Monitoring and Management of Leak Detection System (LDS/secondary sump)

III.11.F.2.a Permittees shall manage the leachate in the LDS system in a manner that does not allow the fluid head to exceed 30.5 cm above the LDS liner [WAC 173-303-665(2)(h)(ii)].

III.11.F.2.b Permittees shall monitor and record leachate removal for comparison to the Action Leakage Rate (ALR) as described in Appendix 4C, Response Action Plan. If the leachate flow rate in the LDS exceeds the ALR, the Permittees shall implement the Ecology approved response action plan (Appendix 4C).

III.11.F.2.c Leachate from the LDS (secondary sump) shall be sampled semi-annually if a pumpable quantity of leachate is available for sampling.

III.11.F.2.d Accumulated liquid of pumpable quantities in the LDS will be managed in a manner that does not allow the fluid head to exceed 30.5 cm above the LDS liner [WAC 173-303-665(2)(h)(ii) and (iii)]. Liquid with a depth greater than 30.5 cm above the LDS liner will be removed at the earliest practicable time after detection (not to exceed 5 working days).

III.11.F.3 Monitoring and Management of the SLDS

III.11.F.3.a At least 180 days prior to initial waste placement, the, the Permittees shall submit to Ecology for approval a sub-surface liquids monitoring and operations plan (SLMOP) for the SLDS to include the following: monitoring frequency, pressure transducer configuration, liquid collection and storage processes, sampling and analysis and response actions. The SLMOP shall be approved by Ecology prior to placement of waste in the IDF, and incorporated into the Permit as a Class [1]1 modification.

III.11.F.3.b Permittees shall monitor and manage the SLDS (tertiary sump) pursuant to the approved sub-surface liquids monitoring and operations plan.

III.11.F.3.c Accumulated liquid of pumpable quantities in the SLDS will be managed in a manner that does not allow the fluid head to exceed 30.5 cm above the SLDS liner [WAC 173-303-665(2)(h)(ii) and (iii)]. Liquid with a depth greater than 30.5 cm above the SLDS liner will be removed at the earliest practicable time after detection (not to exceed 5 working days).

III.11.F.3.d After initial waste placement, Permittees shall manage all leachate from the permitted cell as dangerous waste in accordance with WAC 173-303.

III.11.G CONSTRUCTION WATER MANAGEMENT

III.11.G.1 During construction, it is anticipated that liquids will accumulate on top of all liners and sumps. Permittees shall manage the construction wastewater in accordance with State Waste Discharge Permit ST 4511.

III.11.G.2 Liquid accumulation within the LCRS, LDS, and SLDS prior to initial waste placement will be considered construction wastewater (i.e., not leachate).

III.11.H LANDFILL LINER INTEGRITY MANAGEMENT & LANDFILL OPERATIONS

III.11.H.1 Permittees shall design, construct, and operate the landfill in a manner to protect the liners from becoming damaged. Temperature: Waste packages with elevated temperatures shall be evaluated and managed in a manner to maintain the primary (upper) liner below the design basis temperature for the liner (e.g.,160 F). Weight: Waste, fill material and closure cover shall be placed in a manner that does not exceed the allowable load bearing capacity of the liner (weight per area 13,000 lb/ft^2). Puncture: At least 3 feet of clean backfill material shall be placed as an operations layer over the leachate collection and removal system to protect the system from puncture damage.

III.11.H.1.a All equipment used for construction and operations inside of the IDF shall meet the weight limitation as specified in Permit Condition III.11.H.1. Only equipment that can be adequately supported by the operations layer as specified in Permit Condition III.11.H.1 (e.g., will not have the potential to puncture the liner) shall be used inside of the IDF. All equipment used for construction and operations outside of the IDF shall not damage the berms. Changes to any equipment will follow the process established by condition II.R of the site wide permit. Within 120 days from the effective date for the permit, a process for demonstrating compliance with this condition shall be submitted for review by Ecology. This process will be incorporated into appropriate IDF operating procedures prior to IDF operations.

III.11.H.2 The Permittees shall construct berms and ditches to prevent run-on and run-off in accordance with the requirements of Chapter 4, Section 4.3.8 of the IDF portion of this permit. Before the first placement of waste in the IDF, the Permittees shall submit to Ecology a final grading and topographical map on a scale sufficient to identify berms and ditches used to control run-on and run-off. Upon approval, Ecology will incorporate these maps into the permit as a Class [1]1 modification.

III.11.H.3 The Permittees shall operate the RCRA IDF Cell (Cell1) in accordance with WAC 173-303-665(2) and the operating practices described in Chapters 3.0, 4.0, 6.0, 8.0, Addendum J.1, Addendum J.2, and Appendix 4A, §1, subsection 7, except as otherwise specified in this Permit.

III.11.H.4 The Permittees shall maintain a permanent and accurate record of the three-dimensional location of each waste type, based on grid coordinates, within the RCRA IDF Cell (Cell1) in accordance with WAC 173-303-665(5).

III.11.I WASTE ACCEPTANCE CRITERIA

The only acceptable waste form approved for disposal at the RCRA cell of IDF are IDF operational waste, ILAW in glass form from the Waste Treatment Plant (WTP) Low Activity Waste (LAW) Vitrification facility and ILAW from the Bulk Vitrification Research Demonstration and Development facility (up to 50 boxes). Specifics about waste acceptance criteria for each of these wastes are detailed below.

No other waste forms may be disposed at the RCRA cell of IDF unless authorized via a Final Permit modification decision. Requests for Permit modifications must be accompanied by an analysis adequate for Ecology to comply with State Environmental Policy Act (SEPA), as well as by a risk assessment and groundwater modeling to show the environmental impact. Permit Condition III.11.I.5 outlines the process by which waste sources in the IDF are modeled in an ongoing risk budget and a ground water impact analysis.

III.11.I.1 Six months prior to IDF operations Permittees shall submit to Ecology for review, approval, and incorporation into the permit, all waste acceptance criteria to address, at a minimum, the following: physical/chemical criteria, liquids and liquid containing waste, land disposal restriction treatment standards and prohibitions, compatibility of waste with liner, gas generation, packaging, handling of packages, minimization of subsidence.

III.11.I.1.a All containers/packages shall meet void space requirements pursuant to WAC 173-303-665(12).

III.11.I.1.b Compliance Schedule

III.11.I.1.b.i Six months prior to IDF operations, the Permittees shall submit to Ecology for review, approval, and incorporation into the permit any necessary modifications to the IDF Waste Analysis Plan (Chapters 3.0 of the IDF portion of this permit).

III.11.I.2 ILAW Waste Acceptance Criteria

The only ILAW forms acceptable for disposal at IDF are: (1) approved glass canisters that are produced in accordance with the terms, conditions, and requirements of the WTP portion of the Permit, and (2) the 50 bulk vitrification test boxes as specified in the DBVS test plans.

To assure protection of human health and the environment, it is necessary that the appropriate quality of glass be disposed at IDF. The Land Disposal Restrictions (LDR) Treatment Standard for eight metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver), when associated with High Level Waste, is High Level VIT (HLVIT) (40 CFR 268). Because these metals are constituents in the Hanford Tanks Waste, the LDR standard for ILAW disposed to IDF is HLVIT.

For any ILAW glass form(s) that the United States Department of Energy (DOE) intends to dispose of in IDF, DOE will provide to Ecology for review, an ILAW Waste Form Technical Requirements Document (IWTRD). The IWTRD will contain:

III.11.I.2.a WTP ILAW Waste Acceptance Criteria

III.11.I.2.a.i A description of each specific glass formulation that DOE intends to use including a basis for why each specific formulation is proposed for use, which specific tank wastes the glass formulation is proposed for use with, the characteristics of the glass that are key to satisfactory performance (e.g., Vapor Hydration Test (VHT), Product Consistency Test (PCT), and Toxicity Characteristic Leaching Procedure (TCLP) and/or other approved performance testing methodologies that the parties agree are appropriate and necessary), the range in key characteristics anticipated if the specific glass formulation is produced on a production basis with tank waste, and the factors that DOE must protect against in producing the glass to ensure the intended glass characteristics will exist in the actual ILAW.

III.11.I.2.a.ii A performance assessment that provides a reasonable basis for assurance that each glass formulation will, once disposed of in IDF in combination with the other waste volumes and waste forms planned for disposal at the entire IDF, be adequately protective of human health and the environment; and will not violate or be projected to violate all applicable state and federal laws, regulations and environmental standards.

Within 60 days of a request by Ecology, the Permittees shall provide a separate model run using Ecology's assumptions and model input.

III.11.I.2.a.iii A description of production processes including management controls and quality assurance/quality control requirements that assure that glass produced for each formulation will perform in a reasonably similar manner to the waste form assumed in the performance assessment for that formulation.

The Permittees shall update the IWTRD consistent with the above requirements for review by Ecology consistent with their respective roles and authority as provided under the Tri-Party Agreement (TPA). Ecology comments shall be dispositioned through the Review Comment Record (RCR) process and will be reflected in further modeling to modify the IDF ILAW Chapter 3.0, Waste Analysis Plan as appropriate.

The initial IWTRD contained glass formulation data as required by Permit Condition III.11.I.2.a.i, and was submitted on December 18, 2006 (AR Accession # 0906020182). The performance assessment required by Permit Condition III.11.I.2.a.ii, and the quality assurance/quality control requirements process required by Permit Condition III.11.I.2.a.iii shall be submitted for Ecology review as soon as possible after issuance of the Final Tank Closure and Waste Management Environment Impact Statement (EIS) and receipt of underlying codes and data packages, and at least 180 days prior to the date DOE expects to receive waste at IDF. At a minimum, the Permittees shall submit updates to the IWTRD to Ecology every five years or more frequently with the next one due June 30, 2015, if any of the following conditions exist:

- The Permittees submits a permit modification request allowing additional waste forms to be disposed of at IDF.
- The WTP or other vitrification facility change their glass formulations from those previously included in the IWTRD.
- An unanticipated event or condition occurs that Ecology determines would warrant an update to the IWTRD.

III.11.I.2.a.iv The Permittees shall not dispose of any WTP ILAW not described and evaluated in the IWTRD.

III.11.I.3 ILAW Waste Acceptance Criteria Verification.

III.11.I.3.a Six months prior to disposing of ILAW in the IDF, the Permittees will submit an ILAW verification plan to Ecology for review and approval. This plan will be coordinated with WTP, Ecology, and the Permittees personnel. This plan will outline the specifics of verifying ILAW waste acceptance through WTP operating parameters, and/or glass sampling. The Plan will include physical sampling requirements for batches, glass formulations, and/or feed envelopes.

III.11.I.4 DBVS Bulk Vitrification Waste Acceptance Criteria

III.11.I.4.a Bulk Vitrification waste forms that are acceptable to be disposed of at IDF are up to 50 boxes of vitrified glass produced pursuant to the DBVS Research, Development, and Demonstration (RD&D) Permit from processing Hanford Tank S-109 tank waste.

III.11.I.4.b If Bulk Vitrification is selected as a technology to supplement the Waste Treatment Plant, the IDF portion of the Permit will need to be modified to accept Bulk Vitrification Full Scale production waste forms. This modification will need to be accompanied by appropriate TPA changes (per M-062 requirements) and adequate risk assessment information sufficient for the Department of Ecology to meet its SEPA obligations.

III.11.I.4.c DBVS Waste Acceptance Verification will occur on 100% of the waste packages. Pursuant to the DBVS RD&D Permit, a detailed campaign test report will be produced and submitted to Ecology detailing results of all testing performed on each waste package that is produced. IDF personnel shall review these reports to verify that the waste packages meet IDF Waste Acceptance Criteria.

III.11.I.4.d The Permittees shall not dispose of any waste forms that do not comply with all appropriate and applicable treatment standards, including all applicable LDR.

III.11.I.5 Modeling – Risk Budget Tool

III.11.I.5.a The Permittees must create and maintain a modeling - risk budget tool, which models the future impacts of the planned IDF waste forms (including input from analyses performed as specified in Permit Conditions III.11.I.2.a through III.11.I.2.a.ii) and their impact to underlying vadose and ground water. This software tool will be submitted for Ecology review as soon as possible after issuance of Final Tank Closure and Waste Management EIS and receipt of underlying codes and data packages, and at least 180 days prior to the date DOE expects to receive waste at IDF. The risk budget tool shall be updated at least every 5 years. The model will be updated more frequently if needed, to support permit modifications or SEPA Threshold Determinations whenever a new waste stream or significant expansion is being proposed for the IDF. This risk budget tool shall be conducted in manner that is consistent with state and federal requirements, and represents a risk analysis of all waste previously disposed of in the entire IDF (both cell 1 and cell 2) and those wastes expected to be disposed of in the future for the entire IDF to determine cumulative impacts. The groundwater impact should be modeled to evaluate fate and transport in the groundwater aquifer(s) and should be compared against various performance standards including but not limited to drinking water standards (40 CFR 141 and 40 CFR 143). Ecology will review modeling assumptions, input parameters, and results and will provide comments to the Permittees. Ecology comments shall be dispositioned through the RCR process and will be reflected in further modeling to modify the IDF ILAW waste acceptance criteria as appropriate.

III.11.I.5.a.i The modeling-risk budget tool will include a sensitivity analysis reflecting parameters and changes to parameters as requested by Ecology.

III.11.I.5.a.ii If these modeling efforts indicate results within 75% of a performance standard [including but not limited to federal drinking water standards (40 CFR 141 and 40 CFR 143)], Ecology and the Permittees will meet to discuss mitigation measures or modified waste acceptance criteria for specific waste forms.

III.11.I.5.a.iii When considering all the waste forms to be disposed of in IDF, the Permittees shall not dispose of any waste that will result (through forward looking modeling or in real groundwater concentrations data) in a violation of any state or federal regulatory limit, specifically including but not limited to drinking water standards for any constituent as defined in 40 CFR 141 and 40 CFR 143.

III.11.I.6 The Permittees shall not dispose of any waste that is not in compliance with state and federal requirements as identified in Chapter 13.0.

III.11.I.6.a In accordance with DOE's authority under the Atomic Energy Act of 1954, as amended and other applicable law, prior to disposing of any mixed ILAW in the IDF, DOE will certify to the State of Washington that it has determined that such ILAW is not high-level waste and meets the criteria and requirements outlined in DOE's consultation with the U.S. Nuclear Regulatory Commission beginning in 1993 (Letter from R.M. Bernero, USNRC to J. Lytle, USDOE, dated March 2, 1993; Letter from J. Kinzer, USDOE, to C. J. Paperiello, USNRC, Classification of Hanford Low-Activity Tank Waste Fraction, dated March 7, 1996; and Letter from C.J. Paperiello, USNRC, to J. Kinzer, USDOE, Classification of Hanford Low-Activity Tank Waste Fraction, dated June 9, 1997). While the requirement to provide such certification is an enforceable obligation of this permit, the provision of such certification does not convey, or purport to convey, authority to Ecology to regulate the radioactive hazards of the waste under this permit.

III.11.I.7 IDF Operational Waste Acceptance Criteria.

III.11.I.7.a IDF operational activities (including decontamination, cleanup, and maintenance) will generate a small amount of waste. Waste that can meet IDF waste acceptance without treatment will be disposed of at the IDF. All other IDF operational waste will be managed pursuant to WAC 173-303-200.

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PART III, OPERATING UNIT 11 UNIT-SPECIFIC CONDITIONS INTEGRATED DISPOSAL FACILITY

This document sets forth the operating conditions for the Integrated Disposal Facility (IDF).

III.11.A COMPLIANCE WITH APPROVED PERMIT

The Permittees shall comply with all requirements set forth in the Integrated Disposal Facility (IDF) Permit conditions, the Chapters and Appendices specified in Permit Condition III.11.A and the Amendments specified in Permit Conditions III.11.B through III.11.I. All subsections, figures, and tables included in these portions are enforceable unless stated otherwise:

OPERATING UNIT 11:

Chapter 1.0	Part A Form, dated October 1, 2008
Chapter 2.0	Topographic Map Description, dated September 30, 2014
Chapter 3.0	Waste Analysis Plan, dated June 30, 2013
Chapter 4.0	Process Information, dated December 31, 2008
Appendix 4A	Design Report (as applicable to critical systems), dated June 30, 2016
Appendix 4B	Construction Quality Assurance Plan, dated April 9, 2006
Appendix 4C	Response Action Plan, dated April 9, 2006
Appendix 4D	Construction Specifications (RPP-18489, Rev. 1), dated December 31, 2006
Chapter 5.0	Ground Water Monitoring, dated June 30, 2010
Chapter 6.0	Procedure to Prevent Hazards, dated June 20, 2013
Addendum J.1	Contingency Plan – Pre-Active Life, dated ~~August 21, 2018~~TBD
Addendum J.2	Contingency Plan – Active Life, dated March 31, 2016
Chapter 8.0	Personnel Training, dated September 30, 2014
Chapter 11.0	Closure, dated September 30, 2014
Chapter 13.0	Other Federal and State Laws, dated April 9, 2006

General and Standard Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, WA7890008967 (Permit) conditions (Part I and Part II Conditions) applicable to the IDF are identified in Permit Attachment 9 (Permit Applicability Matrix).

III.11.B AMENDMENTS TO THE APPROVED PERMIT

III.11.B.1 Portions of Permit Attachment 4, *Hanford Emergency Management Plan* that are not made enforceable by inclusion in the applicability matrix for that document, are not made enforceable by reference in this document.

III.11.B.2 Permittees must comply with all applicable portions of the Permit. The facility and unit-specific recordkeeping requirements are distinguished in the General Information Portion of the Permit, and are tied to the Permit conditions.

III.11.B.3 The scope of this Permit is restricted to the landfill construction and operation as necessary to dispose of: 1) Immobilized Low Activity Waste (ILAW) from the WTP, and 2) the Demonstration Bulk Vitrification System (DBVS) and IDF operational waste as identified in Chapter 4.0. Future expansion of the RCRA trench, or disposal of other wastes not specified in this Permit, is prohibited unless authorized via modification of this Permit.